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CONTENTS

Volume 13, Number 9, May 15, 1959

Category	Abstract	Page
GENERAL	7332	987
BIOLOGY AND MEDICINE	7350	989
CHEMISTRY		
General	7464	1005
Radiation and Radiochemistry	7542	1015
Separation Processes for Pu and U	7591	1023
CONTROLLED THERMONUCLEAR PROCESSES	7601	1025
CRITICALITY STUDIES	7622	1027
GEOLOGY AND MINERALOGY	7625	1028
HEALTH AND SAFETY	7652	1031
INSTRUMENTS	7668	1033
METALLURGY AND CERAMICS	7725	1040
PARTICLE ACCELERATORS AND HIGH-VOLTAGE MACHINES	7829	1054
PHYSICS AND MATHEMATICS		
General	7839	1055
Elementary Particles	7946	1070
PHYSICS AND MATHEMATICS (Cont'd)		
Heat Transfer and Fluid Flow	8103	1093
Nuclear Properties and Reactions	8111	1095
Theory	8180	1104
RADIATION EFFECTS ON MATERIALS	8199	1106
RADIOACTIVE WASTE	8219	1108
REACTORS		
General	8225	1110
Power	8268	1115
STABLE ISOTOPE SEPARATION	8341	1127
TECHNOLOGY		
Feed Materials	8344	1127
Raw Materials	8345	1127
PATENTS	8346	1127
CORPORATE AUTHOR INDEX		INDEX-1
PERSONAL AUTHOR INDEX		INDEX-7
REPORT NUMBER INDEX		INDEX-39
SUBJECT INDEX		INDEX-46

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NUCLEAR SCIENCE ABSTRACTS

Volume 13 Number 9 May 15, 1959

GENERAL

Refer also to abstracts 8394 and 8430.

7332 SCR-62
Sandia Corp., Albuquerque, N. Mex.
CIVILIAN APPLICATION RELEASES THROUGH 1958 BY THE TECHNICAL INFORMATION DIVISION: BIBLIOGRAPHY. Jan. 1959. 54p. Contract AT(29-1)-789. $1.50(OTS).

This bibliography gives a numerical listing of the Sandia Corporation technical papers available to the public from the Office of Technical Services, Department of Commerce, Washington 25, D.C. Prices for printed, photostatic, and microfilm copies are included for many of the listings. The literature covered by the bibliography has been made available to the public under the Civilian Application Program of the Atomic Energy Commission by Sandia Corporation, a prime contractor to the AEC. (auth)

7333 SCTM-268-54(51)
Sandia Corp., Albuquerque, N. Mex.
AN INSTRUMENT-TOWER DESIGN FOR A NUCLEAR TEST. W. J. Francy. Dec. 6, 1954. 23p. Contract [AT(29-1)-789]. $4.80(ph), $2.70(mf) OTS.

A method of designing instrument towers for measuring blast phenomena at Nevada Proving Ground is presented. The recommended tower is a fixed-end, unguyed type (cantilever) with a cross section composed of two pipes separated by 2 to 3 diameters and joined rigidly by continuous one-inch side plates. (auth)

7334 UCRL-5124(Rev. 1)
California. Univ., Livermore. Lawrence Radiation Lab.
PHENOMENOLOGY OF CONTAINED NUCLEAR EXPLOSIONS. Gerald W. Johnson and Charles E. Violet. Dec. 1958. 27p. Contract W-7405-eng-48. $1.00(OTS).

On September 19, 1957, the first completely contained nuclear explosion was fired at the Nevada Test Site. The explosion had an energy release equivalent to 1700 tons of high explosive, which was calculated as a total energy release of 1.7×10^{12} calories. The code name "Rainier" was assigned to this burst. From an analysis of cores obtained from drill holes into the Rainier zero site, as well as measurements made in these holes, it was concluded that the radioactivity, with negligible exceptions, was all trapped in the 700 tons of melted rock. When the cavity collapsed this material fell to the bottom of the cavity. Experiments with this material have shown that it is in fine solution in the glass and is unavailable in amounts sufficient to cause ground water contamination. The region produced by the collapse of the cavity, comprising some 200,000 tons, is highly permeable to water and is not contaminated by radioactive debris. The crushed region produced by the shock is much less permeable. Gaseous radioactive fission products did not penetrate into this region during or after the explosion. More than one half the total energy release of the bomb was contained in rock initially at high temperature. Because of the presence of large quantities of water and the high permeability of the central region, the heat redistributed itself to the temperature of boiling water. The seismic ground shock was not felt beyond a distance of 2.5 miles. Electrical cabling and electronics recording systems housed in a light metal-frame building at a distance of 2,000 ft from the center of detonation suffered no damage or visually observed effects of any sort. During the month of October, 1958, several additional underground shots were detonated at various scaled depths with energy releases from about 100 tons to more than 20 kilotons. Gross results from these explosions indicate that for explosions in the kiloton region and above complete containment of all radioactive debris can be achieved. (C.H.)

7335 CEA-tr-A478
FILTRES À AIR ET À POUSSIÈRES POUR L'INDUSTRIE. (Air and Dust Filters for Industry.) H. Murmann. Translated into French from Metall 11, 868-73(1957). 26p.

The construction, capacity, and utilization of air and dust filters are described. The four types of filters considered are metallic filters with oil films, dry layer filters, cloth air filters, and electrofilters. (J.S.R.)

7336
STUDY OF ATMOSPHERIC RADIOACTIVITY. J. Cl. Philippot. Bull. inform. sci. et tech. (Paris) No. 19, 2-15(1958) July. (In French)

The different agents affecting the deposition of aerosols, in view of radioactivity measures, are discussed with emphasis on the conditions in which air filtering can be carried out. A new graphic method, for showing experimental data, shows immediately the relative importance of artificial and natural air radioactivity. Results gathered over three years (1955, 1956, and 1957) illustrate the use of this method and supply wide information concerning the radioactivity of the atmosphere in France during that period. (auth)

7337
IONIZING RADIATION USES IN FOOD INDUSTRY. Gabor Török (Inst of Research in Food Preservation).

Energia es Atomtech. 11, 497-502(1958). (In Hungarian)

Radiosterilization of food is discussed, and various methods of radiosterilization, using both fission product and reactor sources, are reviewed. (D.E.B.)

7338

APPLICATION OF RADIOACTIVE ISOTOPES IN THE GAS INDUSTRY. Falentsky. Gaz Woda i Tech. Sanit. 31, No. 12, 465-7(1957). (Translated from Referat. Zhur. Khim. No. 16, 1958, Abstract No. 55176.)

A survey is made of the application of radioisotopes in the gas industry and the coke industry. 16 references. (J.S.R.)

7339

GAS-LUBRICATED BEARINGS IN NUCLEAR ENGINEERING. D. Pantall and C. H. Robinson. Nuclear Eng. 4, 53-8(1959) Feb.

The theoretical and practical differences between bearings lubricated by liquids and gases are examined with particular reference to the hydrodynamic type. (auth)

7340

MULTI-UNIT STEAM GENERATORS. W. B. Sallitt. Nuclear Eng. 4, 66-8(1959) Feb.

The use of a large number of comparatively small heat exchangers, as in the French reactor EDF-1, in contrast to the established British practice of a small number of large heat exchangers, is discussed. (W.L.H.)

7341

STORING AND LOADING RADIOACTIVE SOURCES. Nuclear Power 4, 93(1959) Feb.

The storing and handling of β and γ sources are described. (W.L.H.)

7342

RADIOACTIVITY OF AIR DUST. J. Bosch and G. Ulsenheimer (Frieseke & Hoepfner GmbH, Erlangen, Ger.). Nukleonika 1, 157-9(1958) Dec. (In German)

The results obtained with a continuously recording measurement of the radioactivity of air dust leads to the conjecture that in the free air the present long-lived activity is bound to isolated occurring highly radioactive particles. (tr-auth)

7343

USE OF RADIOISOTOPES IN RESEARCH AND TECHNOLOGY IN USSR. P. S. Savitskii. Nukleonika 3, 575-82(1958). (In Polish)

Isotopic techniques in radiation chemistry, agriculture, and metallurgy and some remarks on economical aspects of use of radioisotopes are described. (tr-auth)

7344

NON-MILITARY USES OF NUCLEAR EXPLOSIVES. Gerald W. Johnson and Harold Brown. Sci. American 199, No. 6, 7p.(1958) Dec.

Information is presented on an underground nuclear detonation (Rainier Burst) that was equivalent to 1,700 tons of TNT. The device was buried at a depth of 899 ft in a horizontal tunnel that was driven into the sloping side of a mesa in Nevada. Considerations are given to the use of underground nuclear explosions for power production and mining and the possibility of using surface explosions for excavating harbors. (J.H.M.)

7345

EINFUHRUNG IN DIE ATOMPHYSIK. (Introduction to Atomic Physics.) Wolfgang Finkelnburg. Berlin, Springer-Verlag, 1958. 546p.

A textbook on atomic physics is presented. A discussion of atoms, ions, electrons, nuclei, and photons serves as an introduction to a detailed consideration of atomic spectra and structure, quantum mechanics, atomic theory, nuclear physics, molecular physics, and solid state physics. (J.S.R.)

7346

ELECTRONIC DIGITAL COMPUTERS. Their Use in Science and Engineering. Franz L. Alt. New York, Academic Press Inc., 1958. 344p.

The extremely rapid growth in the production and use of electronic computers has created a wide need for information about these machines. The present volume is intended to serve as an introduction to this field. It is meant for users of computers who wish to understand the principles underlying their design and operation. Sections are presented on background, description, coding and programming, and problem analysis. (W.D.M.)

7347

NUCLEAR EXPLOSIONS AND THEIR EFFECTS. Delhi, The Publications Division, 1958. 354p.

A brief historical background is given of the development of the atomic bomb. Also included is an account of the Hiroshima-Nagasaki bombing, plus some information on the testing and production of nuclear weapons by the United States, United Kingdom, and Russia. More detailed consideration is given to the following: the scientific principles of fission and fusion explosions; the energy released in fission and the radioactivity of fission products; blast, thermal, and radiological effects of nuclear explosions; long-term radiological hazards from fall-out; and genetic effects of nuclear explosions. A brief account is given of the fission chain process, the concept of critical size, and the principles of implosion as applied to nuclear explosions. Limited information is presented on the controlled release of thermonuclear energy and catalyzed fusion reaction. Discussions are included on dose rates from radiation sources inside and outside the body, the effect of nuclear explosions on the weather, and the contamination of fish and marine organisms. (J.H.M.)

7348

REPORT OF THE FBI [FEDERATION OF BRITISH INDUSTRIES] CONFERENCE ON NUCLEAR ENERGY HELD AT EASTBOURNE, 10-12 APRIL 1958. London, Federation of British Industries, 1958. 194p. $2.10.

Topics included in the proceedings are: the impact of nuclear energy upon industry; nuclear energy and the world's fuel and power requirements; financial and investment aspects, including home and overseas markets; survey of reactor types; radioisotopes and their uses; new materials for nuclear engineering; reactor instrumentation; and fabrication and processing of fuel elements. (J.H.M.)

7349

1er SEMINARIO DE ENERGIA NUCLEAR 1957. (1st Seminar of Nuclear Energy, 1957). Madrid, Hidroelectrica Moncabril, S. A., 1958. 169p.

A compilation of the lectures given at the 1st Seminar on Nuclear Energy held in Madrid in 1957 is presented. The topics discussed include materials used in reactor construction, chain reactions, constitution of matter, natural uranium reactors, characteristics of power and research reactors, economic development of power reactors, effect of discovery of nuclear energy on human

thought, geology of fissionable material in Spain, course in atomic energy for industrial leaders, effects of nuclear energy in the United States and Europe, nuclear technology and economics, metallurgy in utilization of nuclear energy. nuclear energy for fusion process, instruments for radiation detection and control, selection and construction of a nuclear system, and international atomic organizations. (J.S.R.)

BIOLOGY AND MEDICINE

7350 AD-203175
Michigan. Univ., Ann Arbor. Engineering Research Inst.
DETERMINATION OF RADIATION STERILIZATION DOSE FOR CANNED MEAT. Progress Report No. 4 for February 1, 1958—March 31, 1958. Lloyd L. Kempe. 7p. Project No. 7-84-01-002. Contract DA-19-129-qm-964.

Progress is reported in studies on the effects of preirradiation of canned green peas on the temperature subsequently required for sterilization, the radiation sterilization dose required for canned meat, and determination of combined irradiation-heat processing treatments required to sterilize canned meat products. Preliminary results are reported. (C.H.)

7351 AECU-3967
Brigham Young Univ., Provo, Utah.
THE EFFECTS OF X-IRRADIATION UPON EMBRYONIC DEVELOPMENT IN THE PARADISE FISH, MACROPODUS OPERCULARIS, WITH SOME NOTES ON NORMAL STAGES. A. Lester Allen. [1958]. 37p. Contract AT(11-1)-349. $6.30(ph), $3.00(mf) (OTS).

Results are reported from a histological and morphological study of the age-radiosensitivity relationship in the embryonic organs of the Paradise fish, Macropodus opercularis. A summary of normal development is presented, followed by a detailed description of twelve selected organs or systems in which the effects of irradiation on certain critical periods of development are considered. (C.H.)

7352 AF-SAM-59-29
School of Aviation Medicine, Randolph AFB, Tex.
EFFECTS OF IONIZING RADIATION UPON HUMAN PSYCHOMOTOR SKILLS. Robert B. Payne. Dec. 1958. 10p.

The effects of radiation exposure on the performance of psychomotor tasks were investigated in human subjects. Data on dose-response function for three standard tests are presented graphically. (C.H.)

7353 CISE-60
Centro Informazioni Studi Esperienze, Milan and Milan. Universita. Istituto di Radiologia.
A COLLECTION OF CURVES OBTAINED WITH A HYDRODYNAMIC MODEL SIMULATING SOME SCHEMES OF BIOLOGICAL EXPERIMENTS CARRIED OUT WITH TRACERS. C. Garavaglia, C. Polvani, and R. Silvestrini. Oct. 1958. 45p.

An analogic hydrodynamic model is described, using phosphorus-32 as radioactive tracer, which can supply useful information on the form and on some characteristics of the curves generally obtained in biological experiments carried out with tracers. A terminology is fixed in order to describe the experiments and the relative phenomena involved; the results obtained with this model in the study of 20 different systems, both elementary and moderately complex, are then reported. (auth)

7354 HW-52368
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
TECHNIQUES FOR EXPOSURE OF MICE TO AEROSOLS OF RADIOACTIVE PARTICLES. D. H. Willard, W. J. Bair, L. A. Temple, and V. H. Smith. Nov. 1, 1958. 21p. Contract W-31-109-Eng-52. $0.75(OTS).

An exposure chamber, glove box, radioactive particle generators, and auxiliary equipment for respiratory exposures of mice to atmospheres of radioactive particles are described. Methods for exposing mice to radioactive aerosols as dust or as particles suspended in fog are also presented with data from typical experiments demonstrating the relative merits of the techniques. The design of the equipment emphasizes safe administration of radioactive aerosols to mice. (auth)

7355 HW-56558
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
RETENTION AND LOCALIZATION OF PHOSPHORUS-32 IN RAT OVARY. Bergene Kawin. Nov. 21, 1958. 10p. Contract W-31-109-Eng-52. $1.80(ph), $1.80(mf) OTS.

Data for retention of P^{32} in ovary and bone over a period of 56 days following single intraperitoneal administration were obtained. Concentrations of P^{32} in ovary decreased as a power function with time. Concentrations in bone remained constant throughout the experimental period. Autoradiograms showed that P^{32} was heterogeneously localized in ovary tissue. Application of these findings to the establishment of maximum permissible concentrations is discussed. (auth)

7356 HW-58221
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
BEHAVIOR OF I^{131} FOLLOWING ITS INHALATION AS A VAPOR AND AS A PARTICLE. D. H. Willard and W. J. Bair. Dec. 24, 1958. 16p. Contract W-31-109-Eng-52. $3.30(ph), $2.40(mf) OTS.

The behavior of I^{131} in mice following its inhalation as a vapor and as an insoluble particle, AgI, is described. About 70 per cent of inhaled I^{131} and only 12 per cent of inhaled AgI^{131} particles were deposited. In both cases I^{131} was rapidly transferred from the initial sites of deposition to the circulatory system as evidenced by rapid appearance of I^{131} in other tissues. After 20 to 30 hours maximum thyroid uptake was observed, 2.5 per cent of total I^{131} vapor inhaled and 1.6 per cent of total inhaled as AgI^{131}. After inhalation of both soluble I^{131} vapor and insoluble AgI^{131} particles about 60 per cent of the total body burden of I^{131} was present in thyroid. The authors do not recommend changes in presently established $MPC_{(air)}$ values for I^{131} but do not point out the possible pitfalls of basing an MPC calculation on the solubility of a compound in pure substances instead of in tissue fluids. (auth)

7357 NP-7273
Texas. Agricultural Experiment Station, College Station.
A LONG RANGE INVESTIGATION OF THE NUTRITIONAL PROPERTIES OF IRRADIATED FOOD. Progress Report No. III [for] September 1, 1954 to July 1, 1955. L. R. Richardson. 8p. Contract DA-49-007-MD-582.

Observations are summarized on the second generation of rats maintained on a diet of irradiated food. The

incidence of blindness was about 5 times higher in the offspring from mothers receiving irradiated diets than in those receiving the untreated diet. Supplements of folic acid added to an irradiated diet for chicks had no effect on the growth of the chicks. (C.H.)

7358 NP-7276

Texas. Agricultural Experiment Station, College Station.

A LONG RANGE INVESTIGATION OF THE NUTRITIONAL PROPERTIES OF IRRADIATED FOOD. Progress Report No. VI [for] January 1, 1956–April 1, 1956. L. R. Richardson. 20p. Contract DA-49-007-MD-582.

Observations are summarized on reproduction and longevity of rats maintained for four generations on an irradiated diet. The untreated diet appeared to be slightly superior for promotion of growth, especially in the third generation. Results of studies on chicks indicated choline is not destroyed by irradiation of the diet or of a solution which contains a high concentration of choline chloride. When the diet contained relatively small amounts of vitamin K, the irradiation process destroyed most of the vitamin activity. No significant changes were observed in enzyme activity in rats receiving normal and irradiated diets. (C.H.)

7359 NP-7279

Texas. Agricultural Experiment Station, College Station.

A LONG RANGE INVESTIGATION OF THE NUTRITIONAL PROPERTIES OF IRRADIATED FOOD. Progress Report No. IX [for] October 1, 1956 to January 1, 1957. L. R. Richardson. 16p. Contract DA-49-007-MD-582.

The percent of litters and of young weaned in four generations of rats maintained on an irradiated diet was slightly less than controls. Food consumption was approximately the same in both groups. The average weight of young at 21 days was approximately 4 grams less in the group receiving the irradiated diet, and the incidence of blindness in the young was higher in this group. The mortality rate, average age at death, reproductive ability, and life span were the same for both groups. Studies with chicks indicate that vitamins A and alpha tocopherol were destroyed when the complete diet was irradiated. The source of fat in the diet had no effect on the stability of these two vitamins to irradiation. Some destruction was observed in thiamine, riboflavin, pyridoxine, pantothenic acid, and folic acid when a solution containing these vitamins was irradiated. It was concluded that a diet consisting entirely of irradiated foods should be supplemented by vitamins. (C.H.)

7360 NP-7280

Texas. Agricultural Experiment Station, College Station.

A LONG TERM FEEDING STUDY ON CHICKEN AND GREEN BEANS. Progress Report No. 1. L. R. Richardson. 9p. Contract DA-49-007-MD-582.

No differences were noted in the weight gain or in blood values in rats maintained for 12 weeks on a diet of irradiated chicken and green beans and a control group maintained on a nonirradiated diet. (C.H.)

7361 NP-7283

Texas. Agricultural Experiment Station, College Station.

A LONG TERM FEEDING STUDY ON CHICKEN AND GREEN BEANS. Progress Report No. III [for] September 1, 1957 to March 1, 1958. General Progress Report No. XI [on] A LONG RANGE INVESTIGATION OF THE NUTRITION PROPERTIES OF IRRADIATED FOOD. L. R. Richardson. 22p. Contract DA-49-007-MD-582.

Data are presented from a study of the effects of an irradiated diet on the incidence of blindness in rats. Preliminary results are inconclusive. When an antioxidant was added to pork fatty tissue before irradiation, a chick diet mixture containing 10% irradiated fatty tissue could be stored for 3 weeks at room temperature without marked deterioration. When diets containing pork fatty tissue, irradiated without an antioxidant, were stored one week the chicks grew slowly and mortality was high. When the antioxidant was added to the diet containing irradiated fatty tissue at the time the diet was mixed, the mortality was low and the chicks receiving diets stored for as long as three weeks grew at the same rate regardless of storage period. Rats in the parent and F_1 generation receiving various combinations of irradiated chicken and green beans grew at essentially the same rate as those receiving a control diet. (C.H.)

7362 NP-7298

Polish Academy of Sciences. Inst. of Nuclear Research. Warsaw.

INFLUENCE IN VITRO OF IONIZING RADIATION ON THE BLOOD CLOTTING SYSTEM. Report No. 14/XRb. Z. Latałło, A. Dancewicz, and T. Musiałowicz. Mar. 1958. 14p.

Behavior of the clotting system after exposure of its components to x rays in doses of up to 13,200 r was studied. A small extension of recalcification time in irradiated platelet-poor plasma and deficiency of thromboplastic function after irradiation of platelets and Christmas factor were revealed. No pronounced effect of x rays on the second clotting phase could be demonstrated. Prothrombin time was found to be extended. Differences in behavior of the fibrinolytic system before and after irradiation were not revealed. (auth)

7363 UCLA-431

California. Univ., Los Angeles. Atomic Energy Project.

SEMI-ANNUAL PROGRESS REPORT FOR THE PERIOD ENDING DECEMBER 31, 1958. 68p. Contract AT-04-1-GEN-12. $10.80(ph), $3.90(mf) OTS.

Studies were continued on radiation-induced reactions in aqueous solutions of nitrophenols and ferriprotoporphyrins. No significant changes in serum glycoproteins or seromucoids were detected in embryo chickens and young chicks as a result of irradiation. Progress is reported in studies on: the radiosensitivity of bacteriophages; the influence of whole-body x irradiation on thiamine transport in rat intestine; the histologic changes in bone, marrow, blood, and other body tissues due to localized β irradiation of known intensity from implanted strontium-88 or strontium-90 beads; the effects of whole-body irradiation on nervous responses in cats; carbon-14 studies of fatty acid metabolism in rats; electrophoretic studies of abnormal plasma proteins; the specificity of thyroxin inhibition of acyl phosphatase; an investigation of the pharmacological properties of Mellaril, 2,methylmercapto-10[2-(N-methyl-2-piperdyl)ethyl]-phenothiazine, a new tranquilizer drug; the local toxicity of organic moderators for intact and abraded skin; the effects of oral quinoxaline on radiation mortality in mice; the development of leukemia and

other neoplasms in mice receiving cell-free tissue extracts from a high-leukemia strain; the development of liver function tests using iodine-131-Rose Bengal; development of techniques and equipment for renograms using iodine-131 Miokon in place of Diodrast; the development of highly sensitive tests for the diagnosis of liver and kidney diseases, in which labeled Rose Bengal, colloidal gold-198, Diodrast, and Miokon were used; tracer studies of bone metabolism using bromine-82; double tracer studies of bone metabolism using calcium-45 and strontium-85; the development of radiation detection instruments and chemical dosimeters; an underwater spark pulser, an improved illuminating system for the electron microscope; and techniques for electron microscopic studies of tissues and the spectrographic analysis of plant ash for trace levels of alkali metals; studies on the fate and persistence of strontium-90 and cesium-137 in various locations and biological materials collected in the vicinity of the Nevada Test Site; and aerial surveying for evaluation of fall-out patterns from balloon-supported and low-yield atomic test devices. (For preceding period see UCLA-429.) (C.H.)

7364 UCRL-8513

California. Univ., Berkeley. Lawrence Radiation Lab. BIOLOGY AND MEDICINE SEMIANNUAL REPORT [FOR] APRIL THROUGH SEPTEMBER 1958. Oct. 21, 1958. 76p. Contract W-7405-eng-48. $1.75(OTS).

Data are tabulated from studies of the long-term turnover rates for calcium-45 and strontium-90 in monkeys and rats. Progress is reported in studies on the thyroid uptake and mammary tumor incidence in female rats as a function of dose of injected astatine-211. Data are presented from studies on the radiation chemistry of solutions of pepsin, gelatin, chymotrypsin, yeast dehydrogenase, aqueous acetic acid–oxygen mixtures, oxygen-free formic acid solutions, and glysine–water systems at elevated temperatures. Encouraging results are reported following 340-Mev proton beam or 900-Mev alpha beam pituitary irradiation in patients with breast carcinoma, acromegaly, diabetes mellitus, and other conditions that are under endocrine control through mediation of the pituitary. Laboratory and clinical data indicating the degree of completeness of hypophysectomy are being collected on all patients. Studies were made of the thyroid function of animals subjected to intense alpha-particle or deuteron irradiation of the thyroid area. A method was developed for the separation of iodinated amino acids of the thyroid, and the method applied in tracer studies of the effect of pituitary irradiation on thyroid function in rats. Progress is reported in studies on: the effects of radiation on the permeability of yeast cells to sodium and potassium ions; applications of neutron-activation analysis in determining the constituents in samples of biological materials; the chemical properties and physiological effects of human urinary erythropoietin; the development of analytical methods for the study of blood lipids; the role of heparin in lipid metabolism; the physiological role of lipoproteins in atherosclerosis and relationship to blood pressure and age; the effects of massive doses of a variety of estrogenic substances on the stimulation of liver phagocytic activity; the role of thymus in lymphocyte production; physiochemical studies of yeast metabolism; the effects of pH and anoxia on growth and x-ray sensitivity of Escherichia coli; biological measurements of aging of man; and genetic studies on Drosophila. Routine radiological monitoring activities are summarized. A list is included of publications and papers presented during the period. (For preceding period see UCRL-8265.) (C.H.)

7365 UCRL-8550

California. Univ., Berkeley. Lawrence Radiation Lab. BIOLOGY AND ULTRACENTRIFUGAL METHODOLOGY OF THE HIGH-DENSITY LIPOPROTEINS AND THE PROTEINS OF HUMAN SERUM (thesis). Oliver Francis deLalla. Nov. 25, 1958. 91p. Contract W-7405-eng-48. $2.25(OTS).

A method for the ultracentrifugal analyses of the high-density serum lipoproteins and the serum proteins is described in detail. A randomly collected population consisting of 2297 clinically healthy humans (1961 males and 336 females) constituted the subjects used in this study. Measurements were made on the concentrations of the three high-density classes of lipoproteins (HDL_1, of hydrated density 1.045 g/ml; HDL_2, 1.075 g/ml; and HDL_3, 1.145 g/ml) and of the three protein classes (P_1, a macroglobulin of S rate 19; P_2, the gamma globulin of S rate 6; and P_3, the albumin of S rate 4). The means, the standard deviations of the distributions, and the standard errors of the means were calculated and recorded for the various age categories in both sexes. The Pearson product-moment correlations were calculated, for each group, for each component measured with each other kind of macromolecule measured, including the low-density lipoproteins. The results of the calculations of distributions and correlations are discussed, and some conclusions are drawn from the findings. (auth)

7366 UR-538

Rochester, N. Y. Univ. Atomic Energy Project. STUDIES ON SUB-FABRIC BURNS: THE RELATIONSHIP OF SURFACE APPEARANCE AND DEPTH OF DAMAGE; A METHOD OF STUDY, PRELIMINARY RESULTS, AND OBSERVATIONS OF WOUND HEALING. Kelly M. Berkley. Dec. 8, 1958. 11p. Contract W-7401-eng-49. $0.50(OTS).

Relationships between surface appearance and actual depth of damage of sub-fabric burns have been established for only a few burns. Since surface appearance has been the most widely used criterion for evaluating the ability of fabrics to protect against radiant energy, it is of some importance to know whether or not bare skin and sub-fabric burns of similar appearance are of comparable severity. In this experiment it was found that both types of burn when produced by one second exposures and when graded 3^+ moderate because of their surface appearance are, indeed, equally severe. Observations on healing of the two types of burn suggest no differences in the manner or rate of tissue restoration. (auth)

7367 UR-541

Rochester, N. Y. Univ. Atomic Energy Project. SOME IN VITRO STUDIES OF POLONIUM^{210}-BINDING BY BLOOD CONSTITUENTS. Isaac Feldman and Peter Saunor. Jan. 20, 1959. 13p. $3.30(ph), $2.40(mf) OTS.

The filterability of polonium in the presence of various polycarboxylic and amino acids at near blood pH was studied using 10 mμ pore-diameter filter paper. It was shown that homogeneous pH adjustment, using urea and ammonium chloride plus heat, gave much better reproducibility than was obtained by adjusting the pH of polonium solutions with droplets of sodium hydroxide. It was also found that, contrary to previous work of others, the per cent filterability of near-neutral polonium suspensions is independent of the total polonium concentra-

tion below 2000 d/m/ml. The conclusion was drawn that in tracer concentration any polonium carried in blood in a diffusible form is probably bound about 75% to citrate and about 20% to bicarbonate, the remaining few per cent being complexed by malate and phosphate ions. In agreement with the in vivo studies by Thomas, it was concluded further that the polonium-affinity should be relatively strong for most plasma proteins, since the binding is not limited to any one functional group in protein and should be roughly additive. A brief discussion was given relating the phenomena of radiocolloid formation, hydrolytic polymerization and anion penetration to the chemistry of polonium in vitro and in vivo. (auth)

7368 AERE-Lib/Trans-803

STUDIES OF THE VALUE OF HAEMATOLOGICAL CONTROL IN CASES OF CHRONIC RADIATION EXPOSURE. Ole G. Backer. Translated by M. K. Rundo from a Thesis submitted to the University of Copenhagen, 1958. 52p.

Data are reviewed from bi-annual blood counts on the staff of the Finsen Institute and Radium Centre covering the period 1933 through 1954. The relationship of radiation dosage to blood picture was surveyed. The influence of certain technical variations, short-term physiological variations, and differences in individual radiosensitivity on fluctuations in the blood picture are considered. It was concluded that there is a correlation between radiation dose and biological response. However, the large technical and physiological variations limit the value of blood counts as an indication of radiation injury in the low-dose range. 98 references. (C.H.)

7369 CEA-tr-A477

ASPECTS PRATIQUES DE LA PROTECTION CONTRE LES RAYONNEMENTS. (Practical Aspects of Protection Against Radiations.) Georg Moal. Translated from Atomkernenergie 2, 141-3(1957). 13p.

A résumé of the essential data for radiation protection presented in The Handbook of Dangerous Materials by N. Irving Sax is given. The radiation units of current use in the United States are defined. The essential problems caused by alpha particles, beta particles, gamma and x radiation, neutrons, and protons and the measurement of each are discussed briefly. (J.S.R.)

7370 JPRS-281

INFLUENCE OF EXTERNAL X- AND INTERNAL BETA-IRRADIATION ON THE DEVELOPMENT OF ASEPTIC INFLAMMATION. T. S. Barkagan. Translated from Patolog. Fiziol. i Eksptl'. Terap. 2, No. 1, 19-21(1958). 7p. (PB-141144-T). $0.50 (OTS).

Under the influence of total irradiation with non-lethal doses of x rays (500 roentgens), a suppression of the development of the inflammatory reaction, produced by the injection of turpentine into mice on the fourth day after the irradiation, occurs: the development of inflammatory edema is inhibited, and the barrier function of the inflammatory reaction is decreased. When mice are injected with lethal doses of $Na_2HP^{32}O_4$, no suppression of the development of the inflammatory reaction is found, inflammatory edema develops in distinct fashion, and the barrier function remains normal. The difference found in the effects of non-lethal doses of x rays on the non-specific reactivity and of lethal internal beta-irradiation require further study. (auth)

7371 JPRS-282

BLOOD DESTRUCTION IN RADIATION SICKNESS AND THE EFFECT OF HEMOTHERAPY ON THIS PROCESS. M. G. Shitikova. Translated from Patolog. Fiziol. i Eksptl'. Terap. 2, No. 1, 22-7(1958). 10p. (PB-141145-T). $0.50(OTS).

The effect of ionizing radiation on the body is accompanied by an increased destruction of erythrocytes beginning with the first few days after irradiation. Increased bilirubin excretion after irradiation occurs in the form of two phases. The first phase, under the conditions of our experiments, is observed from the second through the sixth to 14th day; the second phase, from the 14th to 18th through the 23rd to 30th day. Early transfusion of freshly citrated blood exerts favorable effect on the general condition of the animal and on hematopoiesis; increased bilirubin excretion thereby is not the direct reflection of the increased destruction of the recipient's erythrocytes. Preliminary transfusion of a solution of heterologous hemoglobin decreases the initial hemolysis of erythrocytes with the development of radiation sickness. The infusion of colloidal infusin (during the first three days after irradiation in combination with the preliminary transfusions of heterologous hemoglobin solution) decreases the destruction of erythrocytes during the first and second phases. The utilization experimentally of animals with biliary-ureteral anastomosos makes it possible to study more profoundly the dynamics of blood destruction in radiation sickness and to evaluate appropriately the completeness of the pathogenetic methods of therapy of radiation sickness. (auth)

7372 JPRS-283

IRON METABOLISM IN RADIATION SICKNESS. L. L. Shepshelevich. Translated from Patolog. Fiziol. i Eksptl'. Terap. 2, No. 1, 27-33(1958). 9p. (PB-141146-T). $0.50 (OTS).

After total x irradiation of rabbits with a dose of 200 r, a brief suppression of erythropoiesis is seen. With the action of 600 roentgens, a considerable depression of hemoglobin-formation is noted as early as the first day after the irradiation. At later periods, the erythropoietic function of the bone marrow is partially recovered, but remains decreased for a month. Total irradiation of dogs with large doses of x rays (600 roentgens) produces a significant depression of erythropoiesis as early as the first few hours after irradiation and an almost complete cessation of hemoglobin-formation in the majority of animals on the first to second day. However, the bone marrow at this time, in certain cases, still contains a significant number of red cells (15-35 percent), which apparently are incomplete in a functional sense. In the irradiation of dogs with large doses of x rays, an accumulation of intravenously injected Fe^{59} occurs in the liver and kidneys, which, apparently is induced by general disturbances of metabolism and the suppressive effect of ionizing radiation on hematopoiesis. Determination of the serum iron in combination with the morphologic analysis of the bone marrow and the peripheral blood can serve as an important index characterizing the condition of hematopoiesis and of blood destruction in radiation sickness. Apparently, as early as the first day after total irradiation of dogs with large doses of x rays (600 r) preparations should be used which make possible the activation of the bone marrow and the recovery of erythropoiesis. (auth)

7373 JPRS-284

THE INFLUENCE OF GENERALIZED X-IRRADIATION ON MINERAL METABOLISM IN BONE TISSUE. N. A. Zhizhina. Translated from Patolog. Fiziol. i Eksptl'.

Terap. 2, No. 1, 34-8(1958). 10p. (PB-141147-T). $0.50(OTS).

Changes induced by radiation in phosphorus-calcium metabolism in bone were studied in rats with the aid of phosphorus-32 and calcium-45. It was concluded that changes in bone mineral metabolism provide an index of the dystrophic processes occurring in bones immediately after exposure to doses of 700 r x radiation. These changes were followed for a period of 50 days. The process of calcification was found to be delayed in irradiated rats, and the process of healing was delayed in irradiated traumatized bones. (C.H.)

7374 JPRS-285

INFLUENCE OF PENTOXYL AND THESANE ON THE PERIPHERAL BLOOD PICTURE IN RADIATION SICKNESS. R. N. Abdullina and Z. Ya. Lagno. Translated from Patolog. Fiziol. i Eksptl'. Terap. 2, No. 1, [39]-44 (1958). 10p. (PB-141148-T). $0.50(OTS).

A study was made of the effects of pentoxyl and thesane-25, which stimulate leukopoiesis, on the leukopenia produced in rabbits following exposure to massive doses of cobalt-60 gamma radiation. Treatment with thesane and pentoxyl before irradiation decreased the degree of leukopenia and delayed its development. In thesane-treated animals marked waves of leukocytosis were observed against a background of radiation-induced leukopenia. When leukopenia was already present, neither pentoxyl or thesane exerted any beneficial effect. No information is included on the chemical nature of the compounds used. (C.H.)

7375 JPRS-286

RADIOAUTOGRAPHY STUDIES OF RAT SARCOMA DURING SARCOLYSIN THERAPY. I. M. Solopayev. Translated from Patolog. Fiziol. i Eksptl'. Terap. 2, No. 1, 44-9(1958). 11p. (PB-141149-T). $0.50(OTS).

The rate of synthesis and the amino acid content of protein in transplanted rat sarcoma were studied using sulfur-35-labeled methionine. Nucleic acid synthesis was studied with phosphorus-32. Microradiographic techniques were employed. The therapeutic effects of sarcolysin injections on the tumors were evaluated and reaction mechanisms are discussed. (C.H.)

7376 JPRS-761

CHANGES OF INTEROCEPTIVE UNCONDITIONED REFLEXES PRODUCED BY THE ACTION OF IONIZING RADIATION. Ye. I. Komarov. Translated from Med. Radiol. 2, No. 3, 3-8(1957). 9p. (PB-141253-T). $0.50(OTS).

A study was made of the effects of whole-body irradiation on reflexes from the mechanico-receptors of various internal organs acting upon blood pressure and respiration. Radiation exposure of cats induced changes in unconditioned reflexes which exhibited a phasic character and on the whole represented a decrease of strength of interceptive reflexes and an increase of their thresholds. Only during the first 24 to 48 hours was a slight increase noted in the strength of the interceptive reflexes. Reaction mechanisms involved are discussed. (C.H.)

7377 JPRS-762

DEVELOPMENT OF ADAPTIVE REACTIONS FOLLOWING REPEATED AND FREQUENT EXPOSURE TO IONIZING RADIATION. Yu. K. Kudritskii (Kudritskiy). Translated from Med. Radiol. 2, No. 3, 8-13(1957). 10p. (PB-141254-T). $0.50 (OTS).

Data are presented which show that adaptive mechanisms are established earlier following repeated irradiation than after the initial exposure. The reactions of a number of organs and systems decrease; this is manifested even in the reaction of individual cells. There is, also, a change of basal metabolism. Although the role of the nervous system has not yet been determined, there are a number of facts which point directly to its participation in the development of adaptive defense reactions to the effect of ionizing radiation. The development of adaptive defense reactions, emerging as a result of the action of ionizing radiation upon the organism, may be considered an irrefutable fact; however, very little is known concerning the mechanisms of formation and the dynamics of these reactions. (auth)

7378 JPRS-767

THE EFFECTIVENESS OF CYSTEINAMINE FOR THE PREVENTION OF RADIATION DISEASE UNDER CLINICAL CONDITIONS. A. I. Strachinin. Translated from Med. Radiol. 2, No. 3, 52-4(1957). 5p. (PB-141252-T). $0.50(OTS).

Observations on patients given cysteinamine while undergoing radiation treatment led to the conclusion that preparations of cysteinamine (mercamine-salicylate and mercamine-hydrochloride) have definite beneficial value in the prevention and treatment of certain symptoms of radiation disease, including nausea, vomiting, and general malaise. These preparations did not prevent the development of leukopenia. (C.H.)

7379

INTESTINAL WEIGHT LOSS IN MICE IRRADIATED BY ROENTGEN RAYS, GAMMA RAYS, AND FAST NEUTRONS. M. A. Patetta-Queirolo, M. L. Randolph, and J. A. Sproul, Jr. (Oak Ridge National Lab., Tenn.). Acta Radiol. 49, 393-400(1958) May.

Groups of 10-week-old female RF mice were exposed to graded doses of Co^{60} gamma rays, 250 kv x rays, or 14-Mev fast neutrons. The weight of the small intestine decreased during the first 48 hours after irradiation as a linear function of dose over the range 50 to 700 rads. No significant differences between radiations in the production of this effect were observed 1 day after irradiation, but at 2 days the RBE was found to increase with LET, being 1.0, 1.5, and 2.0 for gamma rays, x rays, and neutrons, respectively. The RBE of neutrons for intestinal weight loss was appreciably higher than for 30-day lethality, in keeping with the hypothesis that the earlier mortality of mice exposed to neutrons, as opposed to roentgen rays, results from relatively greater injury of the gastrointestinal tract by neutrons. (auth)

7380

DELAYED EFFECTS OF IONIZING RADIATIONS IN MAN. John L. Tullis (New England Deaconess Hospital, Boston). A.M.A. Arch. Pathol. 66, 403-17(1958) Oct.

Serious delayed effects in man can be caused by exposure to ionizing radiations. The interval between radiation exposure and the development of manifestations of injury may be quite variable. Any given response to radiation is the result of the interplay of many physical factors which acting together characterize the agent, and many biological factors which acting together determine the host's response to the agent. A comprehensive discussion of the subject is presented. The discussion is limited to those effects observed as the result of medical and occupational uses of ionizing radiations and does not include detailed consideration of the effects resulting from exposure to either the peace-

ful or military use of nuclear energy. 128 references. (C.H.)

7381

INFLUENCE OF SEED IRRADIATION WITH X-RAYS AND THERMAL NEUTRONS UPON CELL SIZE AND MITOTIC ACTIVITY IN ROOT TIPS OF MAIZE. F. A. Haskins, Merwyn F. Davidson, and Russell J. Beers (Univ. of Nebraska, Lincoln). Am. Naturalist 92, 365-9 (1958) Nov.-Dec.

Cell size, mitotic activity, and nucleic acid content were determined using tips of roots produced by the germination of control, x-irradiated, and thermal neutron-irradiated maize seeds. The dosage levels used had no appreciable effect upon cell width, but small increases in cell length were associated with increasing dose of irradiation. The treatments effected drastic reductions in mitotic activity. A tendency was observed toward decreased amounts of ribonucleic acid per root tip with increasing dose of irradiation, but no consistent relationship was found between desoxyribonucleic acid content and dose. (auth)

7382

ANTIGENS RESPONSIBLE FOR BONE MARROW TRANSPLANTATION IMMUNITY. T. Makinodan, N. Gengozian, and J. F. Albright (Oak Ridge National Lab., Tenn.). Ann. N. Y. Acad. Sci. 73, 757-65(1958) Oct. 7.

The antigens responsible for the bone marrow transplantation immunity were determined by sensitizing the mice 2 or 6 weeks prior to the 950 r and rat bone marrow transplantation (950 r-RBM). Indicative of the sensitizing antigens was the increased mortality 15 and 30 days after 950 r-RBM in comparison to the nonsensitized 950 r-RBM mice. Sensitizing antigens were absent in the serum and red blood cells, but present in nucleated cells. They were localized in the nucleus, mitochondria, and microsomes in a reasonable concentration and in the supernatant fraction in a relatively low concentration. The antigens of the mitochondria and microsomes were resistant to nuclease and protease treatment. The nuclear antigens were resistant to ribonuclease and papain treatment, and slightly susceptible to trypsin. The antigenicity of desoxyribonuclease-treated nuclei was variable. (auth)

7383

SPECTROCHEMICAL DETERMINATION OF STRONTIUM-TO-CALCIUM RATIO IN FOOD, MILK, CREAM, BLOOD, FECES, AND URINE OF COWS. George V. Shalimoff, John G. Conway, and Ann E. Pitzer (Univ. of California, Berkeley). Appl. Spectroscopy 12, No. 4, 120-2(1958).

A d-c carbon-arc spectrochemical method has been developed for the determination of strontium-to-calcium ratios in the food, milk, cream, blood, feces, and urine of cows. In this method sodium is added to the samples to produce uniformly enhanced and reproducible spectral lines in the range of 10^{-4} to 5×10^{-2} strontium-to-calcium ratio. Typical examples of analyses of the food and products of three cows are included, with a precision of ±12%.

7384

SHORT AND LONG-TERM OBSERVATIONS CONCERNING THE EFFECT OF HOMOLOGOUS AND HETEROLOGOUS CELL-FREE SPLEEN EXTRACTS ON RADIATION MORTALITY IN MICE AND GUINEA PIGS. F. Ellinger (National Naval Medical Center, Bethesda, Md.). Atompraxis 4, 439-44(1958).

The present studies implement and extend previous reports of investigations concerned with the radiation protection of cell-free saline extracts from spleens. Previous preliminary data are implemented by showing that cell-free saline extracts from mouse spleens protect guinea pigs against radiation death at 3 radiation dose levels. The reduction of radiation mortality is reflected in the weight change curve of the spleen-extract treated animals, which indicates suppression and reduction of weight loss respectively observed in pertinent saline controls. Protective spleen extracts can also be obtained from the spleens of guinea pigs. The post-irradiation treatment of mice and guinea pigs with mouse spleen extract does not only reduce mortality in both species in the immediate post-irradiation period (up to the 20th post-irradiation day), but that the number of survivors at the 20th post-irradiation day remains unchanged for over 3 months. This survival is accompanied by consistent weight gain in both species, indicative of the absence of late immunobiological response (so-called rejection-reaction) to cellular implants frequently encountered when preparations containing viable cells are used for the modification of the lethal effect of irradiation. Besides this advantage over cell-containing extracts, these cell-free preparations can be stored up to 3 months without a loss in protective effect. (auth)

7385

INHIBITION BY CYTOTOXIC DRUGS OF BONE MARROW REGENERATION AFTER IRRADIATION AND MARROW TRANSPLANTATION. J. W. Hollingsworth (Veterans Administration Hospital, West Haven, Conn. and Yale Univ., New Haven). Cancer Research 19, 165-9(1959) Feb.

The regenerating bone marrow, following irradiation and recolonization with donor marrow intravenously, proved to be markedly sensitive to the effects of cytotoxic drugs. A-methopterin, 6-mercaptopurine, azaserine, and the fluorinated pyrimidines all inhibited marrow regeneration in doses several times smaller than the dose that caused toxic marrow damage. The possible application of these findings to the testing of cytotoxic drugs is discussed. (auth)

7386

DELAYED EFFECTS OF TOTAL IRRADIATION IN SINGLE OR MULTIPLE DOSES AND OF IRRADIATION OF THE HEPATIC REGION ON THE NEUTRAL FATS OF THE LIVER OF THE GUINEA PIG. Odette Lartigue. Compt. rend. 247, 2210-13(1958) Dec. 10. (In French)

Male adult guinea pigs were irradiated under different conditions to determine the effects on the liver fats. The guinea pigs were exposed to a single whole-body dose of 800 r, a whole-body dose of 100 r per week for 8 to 9 weeks, and a 1100 r dose localized in the hepatic region. In all cases, a delayed, diffuse, and moderate steatosis appears 15 weeks after the irradiation. It appears to correspond to a direct action of x radiation on the liver. (J.S.R.)

7387

FORECAST OF THE LIMIT OF ACCUMULATION, IN THE SOIL AND CROPS, OF LONG PERIOD RADIOACTIVE ELEMENTS BROUGHT AT A CONSTANT VELOCITY. Georges Barbier, Fernand Huguet, et al. Compt. rend. 247, 2434-6(1958) Dec. 22. (In French)

The limit of accumulation of Sr^{90} and Ce^{137} in soils and crops is considered. In the discussion it is as-

sumed that the elements are introduced into the soil at a constant rate. The results of experimentation on the amount of the radioisotopes removed in crops irrigated with water containing Sr^{90} and Ce^{137} indicate that the fraction removed is small with respect to their annual rate of decrease. It is suggested that the ratio of the quantity of radioelement absorbed per unit of crop to the quantity of radioisotope in soil units be determined over a period of years. (J.S.R.)

7388

HISTOCHEMICAL BEHAVIOR, ORIGIN, AND ROLE OF RADIO-OPAQUE VESSELS OF TUMORS CAUSED BY AGROBACTERIUM TUMEFACIENS. Janine Salmon. Compt. rend. 248, 734-7(1959) Feb. 2. (In French)

After infection of Pelargonium zonale by the bacteria Agrobacterium tumefaciens, a decisive role appears to be vested in certain vessels and tracheids of the stem in the development of the tumor vessels. Their site at the center of the tumor nodules and the signs of chemical transformation which they show after inoculation are connected to their natural radio opacity to compare them with tumoral meatuses studied previously. (tr-auth)

7389

EFFECT OF X RAYS ON THE SURVIVAL OF A FISH (CARASSIUS CARASSIUS) EXPOSED TO LOW TEMPERATURES. Ch. M. Gros, R. Keiling, J. Bloch, and J. P. Vilain. Compt. rend. soc. biol. 152, 1187-90 (1958). (In French)

The effect of x radiation on the survival of fish (Carassius carassius) at low temperatures was studied. Before irradiation the fish were placed in water at 3°C and kept at that temperature for one day before exposure. The irradiation was made at a temperature of 0°. After irradiation the fish were returned to the aquarium at a temperature of 3° and were observed for fifty days. Five lots of ten each received doses of 2,000, 5,000, 10,000, 15,000, and 20,000 r. After fifty days there were 28 survivors out of 30 in the groups receiving up to 10,000 r. In the samples 21 out of 30 survived. At the end of fifty days the fish were placed in an aquarium at 15°C. The irradiated fish then died much faster than the samples. (J.S.R.)

7390

ON THE WAY THE CONTENT OF GLYCOGEN IN THE LIVER IS AFFECTED BY IONIZING RADIATION. B. M. Graevskaya (Inst. of Genetics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 124, 202-4(1959) Jan. 1. (In Russian)

A sharp decrease in glycogen synthesis was noticed in young mice following whole-body exposure to 600 r of x radiation, while no change in glycogen synthesis was observed in animals with screened liver. After 30 days, 50% of the animals exposed to whole-body irradiation perished while no fatalities took place among animals irradiated locally or with screened liver. The data indicate that changes in glycogen synthesis are determined by direct exposure of liver tissue to ionizing radiation. (R.V.J.)

7391

THE EFFECT OF X-RAYS UPON THE REFLECTORY EXCITABILITY OF THE VAGUS CENTER. M. M. Gromakovskaya (Inst. of Biological Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 124, 205-8 (1959) Jan. 1. (In Russian)

Early changes in the reflectory excitability of the vagus center in irradiated animals were studied in order to establish the ratio between the rates of disturbances in the hematoencephalitic barrier penetrability and the change in the vagus center function. (R.V.J.)

7392

A STUDY OF THE EFFECT OF γ-RAYS OF Co^{60} UPON THE HAEMOCYTES AND CONNECTIVE TISSUE CELLS OF A MOUSE SPLEEN IN THE PROCESS OF EXPLANTATION. A. F. Ivanitskaya (Severtsov Inst. of Animal Morphology, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 124, 209-12(1959) Jan. 1. (In Russian)

Studies of 1000 tissue cultures irradiated by Co^{60} γ rays of 100,000 and 5,000 r showed lymphatic disturbances during irradiation with total deterioration within 24 hours. The exposure of spleen tissue in vitro to 5000 r induces changes in the tissue but does not paralyze the cell properties. The data obtained indicated that of three groups of spleen cells, the reticular, granular, and lymphatic, the latter is the most radiosensitive. (R.V.J.)

7393

ON THE REVERSIBILITY OF CYTOGENETIC INJURIES CAUSED BY RADIATION. N. V. Luchnik and L. S. Tsarapkin (Inst. of Biology, Urals Branch of the Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 124, 213-16(1959) Jan. 1. (In Russian)

Experiments were made with pea seeds and seedlings irradiated by γ rays in order to determine the possibility of particle reversibility of irradiation injuries in chromosomes. Also, the effects of cysteine fixation on dry seedlings after irradiation by 15,000 r and on seedlings after irradiation by 800 r were studied. (R.V.J.)

7394

MODIFICATION OF THE X-IRRADIATION SYNDROME BY LYCOPENE. A. Forssberg, Chr. Lingen, L. Ernster, and O. Lindberg (Univ. of Stockholm). Exptl. Cell Research 16, 7-14(1959) Jan.

Lycopene, injected intraperitoneally as a particulate suspension in irradiated mice, has a moderate curative action both when given before as also shortly after the x-ray dose, as visualized from the increased survival rates. Some aspects of the action with regard to the amounts of lycopene to be given, the time of the injection relative to the dose, as well as the sex of the animals are presented. Similar attempts to evoke a stimulation of the resistance of irradiated animals using various, widely different types of substances, have been made in recent years and the effect of lycopene is discussed with regard to its possible relationship to a general principle. (auth)

7395

QUANTITATIVE CHANGES IN RAT LIVER MITOCHONDRIA FOLLOWING WHOLE BODY IRRADIATION. P. P. Noyes and R. E. Smith (Univ. of California, Los Angeles). Exptl. Cell Research 15-23(1959) Jan.

Mitochondria were isolated from liver homogenates of rats taken at various times after receiving a lethal dose (1000 r) of γ-irradiation. Quantitative assays were made of mass and nitrogen content per mitochondrion and total mass and number of mitochondria per gram of dry liver. A significant depression in total mitochondrial count per liver and in count per gram was observed very early (by 15 minutes) following irradiation. This returned toward a normal level by 6 hours and was es-

sentially within the normal range through 40 or more hours post-irradiation. Concurrent with the early reduction in count was a remarkable increase in unit mitochondrial mass and nitrogen content. The values of these parameters also recovered rapidly to normal. Although the total nitrogen per liver remained essentially unchanged between the controls and all post-irradiation points examined, there was observed a shift from the mitochondrial to the microsomal-soluble fraction at the early points after exposure. These data appear in concert with the conclusion that the immediate result of the ionizing radiation entails a preferential fragmentation of the smaller mitochondria which may be accompanied by some measure of ingestion or adsorption of the fragments by the surviving mitochondrial residuum. From the results of this study and those reported by others it appears that although the mitochondria are transiently damaged by irradiation in vivo, they are soon reconstituted to reach pre-irradiation levels and by a time prior to the recovery of nuclear activities. (auth)

7396

BASIC QUESTION OF X RADIATION DOSIMETRY. R. Glocker (Techn. Hoshschule, Stuttgart). Fortschr. Gebiete Röntgenstrahlen u Nuklearmed. 90, 101-9(1959) Jan. (In German)

Three principal conditions of x-ray dosimetry can be distinguished depending on whether the measured reaction originates from the electrons produced within the measuring volume only, from the influx of secondary electrons produced in the surroundings (photo, Compton, pair electrons) or from the combined effect of both groups of electrons. Any dose measurement may in principle be reduced to a determination of energy, even when the quantity immediately measured does not represent energy. From the result of the measurement the effective energy per unit mass is first derived for the substance in which the measurement is carried out. From this, using mathematical relationship, the effective energy per mass of the substance of interest, i.e. the dose within this substance, is derived. Any practical dosimetry presupposes that the forementioned relationships only imply the use of physical constants of a general character, which do not contain quantities depending on experimental conditions. It is shown that only two equations of this kind exist between the energy absorbed in the measuring body and that absorbed in the substance of interest; one pertains to the electronic equilibrium, the other to the Bragg-Gray principle. In all other cases the measurement has no dosimetric significance. From these principles implications are derived for the possibility of basing the definition of dose units on ionization in air. (auth)

7397

THE EFFECT OF X-RAY IRRADIATION ON THE RESISTANCE OF WHITE MICE TO B. TYPHI ABDOMINALIS. O. G. Alexeva. Vestnik Rentgenol. i Radiol. 32, No. 1, 8-14(1957) Jan.-Feb. (In Russian)

White mice were sensitized by intraperitoneal injection of 2.5 million B. typhi abdominalis Felix Ty_2 or 50 million B. dysenteria Flexner No. 26-w. Four days later they were subjected to total x-ray irradiation with a LD $^{10}/_{13}$ dose (300 r). Experiments on 250 mice showed that in irradiated mice the biologic effect of a sensibilizing dose increases from DL $^{10}/_{13}$ to DL $^{40}/_{13}$ for typhus and from DL $^{3}/_{13}$ to DL $^{24}/_{13}$ for dysentery. Mice sensitized with B. typhus abdominalis and irradiated died after periods typical for radiation sickness, but developed also bacteriemia pointing to a complicated pathologic process. The degree of active antityphus immunization developed after sensibilization by the stated method was determined by intraperitoneal inoculation of 2 DCL (200 million) on the 1, 3, 5, 7, 10, 20, 30 day after irradiation with 300 r. Experiments on 600 mice have shown that the earlier developed immunity does not change during the first days of radiation sickness. During the III period of radiation sickness (3–10th days) and in the reparation period (20–30th days) the survival of experimental mice is 40–45% less than of the unirradiated controls. The reduced tension of active immunity is also manifested by inhibition of phagocytosis in vivo, accumulation of enormous amounts of bacteria in the place of injection, and, protracted bacteriemia. (tr-auth)

7398

SPARSELY CONTRA DENSELY IONIZING RADIATIONS AND THE ORIGIN OF ERECTOID MUTATIONS IN BARLEY. A. Hagberg, Å. Gustafsson, and L. Ehrenberg. Hereditas 44, 523-30(1958).

Data on mutations induced by x radiation and neutrons in barley are used to indicate the significance of parallel analysis of gene mutations. By using different kinds of ionizing radiations, it is shown that a conclusion based on the behavior of one or a few loci may not be extrapolated to other loci. The results indicate that different types of ionizing radiations lead to different genetical results. (C.H.)

7399

MEASUREMENT OF GAMMA RADIATION IN THE HUMAN BODY. Robert L. Schuch (Los Alamos Scientific Lab., N. Mex.). ISA Journal 4p. (1957) May.

Whole-body counters are capable of measuring the natural gamma activity in human beings far below established tolerance levels (0.5 to 100μc). Minute changes of gamma radiation due to fall-out or laboratory contamination could be detected in humans, foodstuffs and miscellaneous materials, and a large number of samples can be processed in a relatively short time. Laboratory experimentation using human beings and animals can be carried out with no discomfort to the subject, and live measurements are obtained using very-low radiation dosages. Present costs of the described detectors range from $20,000 to $50,000. Other considerations are for the selection of clean materials to be used in construction, and for the available space necessary to house such an apparatus. (auth)

7400

TRANSPLANTATION OF BONE MARROW AFTER PRESERVATION AT –70°C. I. R. Schwartz, E. F. Repplinger, C. C. Congdon, and L. M. Tocantins (Jefferson Medical Coll., Philadelphia and Oak Ridge National Lab., Tenn.). J. Appl. Physiol. 11, No. 1, 22-3(1957) July.

Glycerol-treated adult mouse marrow was brought to –70°C at the rate of 1°C per minute to –15° and then at 10° per minute to –70°C according to the technique of Barnes and Loutit. Storage at –70°C was maintained for 8 days in one experiment and for 7 days in another. The frozen marrow was thawed by incubation at 37°C and given intravenously to adult mice after 900 r total-body x irradiation. The preserved marrow was as effective in modifying the lethal effects of irradiation as marrow obtained from the freshly killed mouse. It would seem that adult mouse bone marrow preserved by this tech-

nique can induce survival of lethally irradiated mice. (auth)

7401

FURTHER STUDIES ON THE IONIZING RADIATION INACTIVATION OF BACTERIAL SPORES. Carl Woese (Yale Univ., New Haven). J. Bacteriol. 77, 38–42(1959) Jan.

Previous observations showing that there are two classes of radiation inactivation for bacterial spores are extended to germinating forms. Spores which inactivate in a multiple target fashion inactivate in a two target fashion upon germination, whereas spores which inactivate in a single target fashion inactivate in a single target fashion upon germination. Spores of the multiple target class seem to have a higher content of dipicolinic acid per g of dry spore material than do those of the single target class. (auth)

7402

THE RELATIVE RETENTION OF STRONTIUM AND CALCIUM IN HUMAN BONE TISSUE. George V. Alexander and Ralph E. Nusbaum (Univ. of California, Los Angeles). J. Biol. Chem. 234, 418–21(1959) Feb.

Samples of human rib, milk, vegetables, and dairy cattle feed were collected from five regions in the United States. These samples were analyzed for strontium and calcium by emission spectrographic techniques. A retention factor between cows' milk and the feed used to produce this milk was determined to be 0.13 ± 0.03. A human bone retention factor of 0.18 ± 0.05 was determined by comparing the strontium-calcium ratio observed for the human rib samples and the ratio estimated for the respective diets. The application of these values to the determination of the maximal radiostrontium level in human bone to be expected from the present level of fall-out contamination is discussed. (auth)

7403

THE EFFECT OF X IRRADIATION UPON POTASSIUM RETENTIVITY OF YEAST. A. K. Bruce and J. N. Stannard (Univ. of Rochester, N. Y.). J. Cell. Comp. Physiol. 51, 325–40(1958) June.

Leakage of potassium from yeast receiving 60,000 r of x irradiation was studied by a method analogous to an ion exchange column. Irradiation with 60 kr produces a marked disturbance in the ability of the yeast cell to retain potassium ion. The effect is dependent on the presence of oxygen during irradiation, but is not markedly altered by changes in ionic environment during the measurement period. The manifestation of the radiation effect is very dependent on the substrate present during measurement. In a general way, when substrates associated with high normal leakage rates are used the radiation effect is small and vice versa, with pyruvate a notable exception. There was a fairly linear inverse relationship between normal leakage rate and the magnitude of the radiation effect. Correlation between substrate utilization, as measured by oxygen uptake, and the degree of radiation damage manifested was not as good as that with normal potassium leakage rates. (auth)

7404

THE EFFECT OF URANYL NITRATE ON THE PERMEABILITY OF CHICKEN ERYTHROCYTES. F. R. Hunter (Univ. of the Andes, Bogota, Colombia). J. Cellular Comp. Physiol. 51, 457–60(1958) June.

Observations on the nonelectrolyte permeability of chicken erythrocytes incubated with uranyl nitrate indicate that the uranyl nitrate did not affect the rate of exit of either glycerol or urea from the cells. (C.H.)

7405

ENERGY CONVERSION IN PHOTOSYNTHESIS PROCESSES. Gordon Tollin, Power B. Sogo, and Melvin Calvin (Univ. of California, Berkeley). J. chim. phys. 55, 919–26(1958) Nov.-Dec. (In French)

The photophysical concepts of the solid state are applied to biological substances, especially to material derived from green plants. Resonance signals of photo-induced electron spins were observed in isolated chloroplasts and in other substances from green plants. The growth time was not modified when the temperature was reduced to −140°C. The luminescence of these bodies was also studied under various conditions. The results of this study are found compatible with a mechanism implying the recombination of electrons and holes trapped in a quasi-crystalline lattice. Certain details of such a mechanism are proposed which give an idea of the fashion in which the luminescent energy intervenes during photosynthesis. (tr-auth)

7406

PRIMARY ANTIBODY RESPONSE TO A CLOSELY RELATED HETEROLOGOUS ANTIGEN AFTER VARYING DOSES OF X-RADIATION, AND ITS SIGNIFICANCE TO RELATED BIOLOGIC PHENOMENA. Takashi Makinodan and Nazareth Gengozian (Oak Ridge National Lab., Tenn.). J. Immunol. 81, 513–18(1958) Dec.

The intraperitoneal route of antigen injection in normal adult mice was closely comparable to the intravenous route in terms of induction period, rate of appearance of antibodies and mean peak titer, and was superior only in terms of the mean total titer. Increase in the antigen concentration from 1 to 10% in 1 ml of RBC did not significantly raise the agglutinin titers of 500-r mice on days 6 to 50, but did raise the mean total titer slightly. A curvilinear relation for the radiation dose and antibody response was obtained in terms of the induction period, rate of appearance of antibodies, mean peak titer, and mean total titer. The significance of these findings is discussed. (auth)

7407

EFFECT OF X-RAYS ON PHAGOCYTOSIS. P. A. Buzini (Ministry of Public Health, USSR). J. Microbiol. Epidemiol. Immunobiol. (USSR) (English Translation) 28, 1052–3(1957).

Results are reported from studies on the changes in the phagocytic activity of leukocytes occurring during generalized exposure to various doses of x radiation. Observations made both in vivo and in vitro on cats, rabbits, guinea pigs, and mice indicate that irradiation may either suppress or stimulate phagocytosis, depending on the dose. Reaction mechanisms involved are discussed. (C.H.)

7408

THE EFFECT OF IONIZING RADIATION ON THE DEVELOPMENT OF IMMUNITY TO TETANUS AND TYPHOID. I. A. Shabarov (Military Medical Academy). J. Microbiol. Epidemiol. Immunobiol. (USSR) (English Translation) 28, 1641–5(1958).

The general x-ray irradiation of mice (550 r) 2 days before immunization caused a marked fall in antitoxic (anti-tetanus) and in antibacterial (anti-typhoid) immunity. The immunity developing after the mice had been vaccinated (with 3 injections of tetravalent vaccine and

2 injections of crude toxoid) during a period when they exhibited marked symptoms of radiation sickness was only greater than the natural resistance of non-immunized healthy mice to injections of tetanus toxin and to infection with typhoid bacilli. When mice were immunized 2 days after general irradiation with purified adsorbed toxoid the immunogenic properties of which greatly exceed those of ordinary crude toxoid, they exhibited a higher degree of antitoxic immunity than was obtained with ordinary toxoid; however, the difference in the immunological efficacy of these two preparations was less marked in the irradiated animals than in animals which had not been irradiated. (auth)

7409

THE ACTION OF X-RAYS ON THE VIRULENCE AND ANTIGENIC PROPERTIES OF PASTEURELLA PESTIS. L. I. Leshkovich (Central Asian Plague Research Inst.). J. Microbiol. Epidemiol. Immunobiol. (USSR) (English Translation) 29, 199-204(1958).

Forty-three days after their first exposure to x rays 6 out of 9 virulent strains of P. pestis lost their virulence for mice in a dose of 100,000 organisms; after 9 months a dose of 20,000 million of 7 of the strains was required to cause death in guinea-pigs. The virulence of one strain was tested in guinea-pigs 1 month after the third exposure to radiation; one-half of the experimental animals survived a dose of 1500 million organisms which indicates that the virulence of other strains may be reduced earlier. The vaccine strain was subjected to radiation under the same conditions as the virulent strains; this treatment did not reduce its antigenicity, which proves that x rays have no destructive effect. (auth)

7410

THE EFFECT OF MASSIVE DOSES OF γ-RADIATION ON THE IMMUNOGENIC PROPERTIES OF BACTERIA OF THE INTESTINAL GROUP. M. A. Tumanian, A. P. Duplishcheva, and T. S. Sedova (Gamaleia Inst. of Epidemiology and Microbiology). J. Microbiol. Epidemiol. Immunobiol. (USSR) (English Translation) 29, 497-505 (1958).

Bacteria of the intestinal group were found to be killed by radiation doses of 400,000 to 600,000 r. When spore forms of bacteria were contained in the material, sterilization was achieved by doses of 1.5 to 2 Mr. Applications of radiosterilization are discussed for the preparation of bacterial-cell vaccines, bacterial antigen complexes, chemical vaccines, and the preparation of vaccines made from bacteria killed by radiation. A study was made of the quality, antigenic and immunogenic properties, liability to retain Vi antigen, and toxicity of vaccines and antigenic complexes prepared from irradiated dysentery and typhoid bacteria. It was found that the radio-antigens were less toxic than antigens prepared from formalinized bacteria or from bacteria which had not been killed before the preparation of the antigen. When antigen previously prepared from formalinized bacteria was subjected to radiation, it either did not differ in toxic properties from the unirradiated antigen or was more toxic. Radiovaccines induced antibody formation in the same way as ordinary formalinized vaccines. Experimental data are tabulated. It was concluded that gamma irradiation can be used both for the production of intestinal group vaccines and antigens and for the sterilization of corresponding bacterial preparations already prepared. (C.H.)

7411

LIQUID EMULSION AUTORADIOGRAPHY WITH TRITIUM. David L. Joftes (New England Deaconess Hospital, Boston). Lab. Invest. 8, 131-8(1959) Jan.-Feb.

An autoradiographic technique for low-energy radioisotopes is described which is quick and convenient. The method depends upon dipping prepared histologic specimens, without coverslips, into melted bulk emulsion. The technique may be varied to suit specific research requirements. The use of the dipping techniques for making autoradiograms is superior to the stripping film technique in speed and convenience in making the initial preparations and yields autoradiograms of equal resolution. The technique is recommended for routine use where grain counting will not be done. (auth)

7412

THE USE OF TRITIATED THYMIDINE IN THE STUDY OF DNA SYNTHESIS AND CELL TURNOVER IN HEMOPOIETIC TISSUES. E. P. Cronkite, V. P. Bond, T. M. Fliedner, and J. R. Rubini (Brookhaven National Lab., Upton, N. Y.). Lab. Invest. 8, 263-77(1959) Jan.-Feb.

Thymidine labeled with tritium was used in a series of in vivo and in vitro studies of desoxyribonucleic acid synthesis and turnover in hematopoietic tissues. Problems associated with tritium autoradiography are reviewed, and the effects of radiation from injected tritium are discussed. Results indicate a rapid incorporation of thymidine into the hematopoietic tissues throughout the body. Evidence is presented for the existence of cells circulating in the peripheral blood of normal human beings capable of synthesizing desoxyribonucleic acid and thus able to divide at least once again. Characteristics of this group of cells are described. (C.H.)

7413

STUDIES ON DEOXYRIBONUCLEIC ACID METABOLISM IN HUMAN CANCER CELL CULTURES (HeLa). I. THE TEMPORAL RELATIONSHIPS OF DEOXYRIBONUCLEIC ACID SYNTHESIS TO MITOSIS AND TURNOVER TIME. Robert B. Painter and Ruth M. Drew (Brookhaven National Lab., Upton, N. Y.). Lab. Invest. 8, 278-85(1959) Jan.-Feb.

Brief exposure of the HeLa strain and the HeLa S3 clone cell cultures to tritiated thymidine has been used to perform autoradiographic experiments comparing their DNA synthetic times, turnover times, and the two resting phases of the mitotic cycle. The results have shown slight differences wherein the HeLa strain exhibits slightly less variability in the resting phases but a longer and more variable DNA synthetic time. The importance of using an identical medium when comparing the physiology of different cell cultures has been emphasized by the fact that differences in generation time and DNA synthetic time occur in HeLa cultures when grown in media with differing serum components. (auth)

7414

SPECIFIC FEATURES OF THE DEVELOPMENT, COURSE, AND OUTCOME OF EXPERIMENTAL PNEUMONIA IN ACUTE RADIATION SICKNESS. P. N. Kiselev, R. M. Rabinovich, and I. D. Meter (Central Research Roentgen-Radiological Inst., Ministry of Health, USSR). Med. Radiol. 3, No. 6, 3-10 (1958) Nov.-Dec. (In Russian)

The development, course, and outcome, as well as

the possibility of clinical and roentgenological diagnosis, of experimental pneumonias in acute radiation sickness were studied (tr-auth)

7415

THE EFFECT OF IRRADIATION COMBINED WITH BLOOD LOSS ON THE COURSE AND THE OUTCOME OF PREGNANCY IN EXPERIMENTAL ANIMALS. N. M. Pobedinskii (Inst. of Obstetrics and Gynecology, Ministry of Health, USSR). Med. Radiol. 3, No. 6, 10-16(1958) Nov.-Dec. (In Russian)

White female rats were subjected to a total single x-ray irradiation of (300r). Immediately after the irradiation blood letting (15 to 30% of the total blood volume) was carried out. 2 series of experiments were conducted on pregnant and non-gravid anmals. The total of 155 rats and 882 offsprings were examined. It was established that the course of radiation sickness in pregnant animals differs from that of non-gravid ones (notably regeneration of the red blood in pregnant rats begins earlier than in non-gravid). Blood loss of average degree directly after the irradiation intensifies the regenerative function of the bone marrow in the maternal body and decreases the degree of affection of the hemopoietic organs of the fetus. Extensive blood loss combined with irradiation increases the percentage of stillbirths, although the regenerative function of the bone marrow in the maternal body, is intensified. (tr-auth)

7416

THE EFFECT OF CERTAIN RADIOACTIVE SUBSTANCES ON THE SECRETION OF STOMACH AND SMALL INTESTINE. S. R. Perepelkin (Erisman, Moscow Scientific Research Inst. of Hygiene). Med. Radiol. 3, No. 6, 16-25(1958) Nov.-Dec. (In Russian)

The effect of radon (intoxication by inhalation) on gastric secretion and of polonium (in oral administration) on the function of the gastric and intestinal glands of dogs was studied. Experiments demonstrated the comparatively stable decrease of the gastric secretion under the effect of radon. The cyclic or undulating dynamics of the secretory function is considered to be the result of changing relations between the fundamental nerve processes (excitation and inhibition) at the basis of which lie the different degrees and stages of parabiosis. Radon is secreted with the gastric juice. Polonium is excreted by the kidneys and by the gastrointestinal tract, the latter playing the main role in this function. Polonium is retained in the organism for a long time. (tr-auth)

7417

THE MECHANISM OF DEVELOPMENT OF HEMORRHAGIC DIATHESIS IN ACUTE RADIATION SICKNESS. A. S. Petrova. Med. Radiol. 3, No. 6, 25-9(1958) Nov.-Dec. (In Russian)

Certain components of the blood-coagulating system which play a certain role in the development of the hemorrhagic syndrome in acute radiation sickness were studied. Experiments were carried out on rabbits irradiated with doses of 800 r and on dogs irradiated with 600 r. The qualitative and quantitative changes of the thrombocytes, retraction of the blood clot, and the blood coagulation time were studied. The results of investigations demonstrated that changes of all the indices listed occur previous to clinical manifestations of hemorrhagic diathesis and may serve as early diagnosistic and prognostic signs. The development of hemorrhages in radiation injury depend mainly on the disturbances in the blood-coagulating system and primarily, in the thrombocytic apparatus. The latter is affected from the very first hour after the irradiation. (tr-auth)

7418

STRUCTURAL CHANGES IN CUTANEOUS NERVES IN ACUTE RADIATION SICKNESS. N. N. Garvei (State Scientific Research Inst. of Roentgenology, Ministry of Health, USSR). Med. Radiol. 3, No. 6, 30-5(1958) Nov.-Dec. (In Russian)

Both regressive and progressive changes are found in cutaneous nerve elements in acute radiation sickness. Regressive changes were manifested in the uneven process of silver reduction, increased impregnation, formation of neuroplasmic thickenings and disintegration of the axis cylinders into lumps. These changes could be found even at the early stage of development of the disease, but they were even more pronounced during the acute stage. The changes in the axis sheaths pertain to progressive changes. The latter consists of proliferation, increased tortuousness of the newly formed nerve branches, the foci of hypermyelinization and hypertrophy of the elements of Schwann. Phenomena of regeneration of the nerve fibers were revealed on the 30th day of the disease. However, this process is of peculiar character in radiation sickness since the newly formed nerve endings are unstable and may later be subjected to destructive processes. The normal structure of cutaneous nerves did not show complete recovery in 2 months following the irradiation. (tr-auth)

7419

THE EFFECT OF ETHYLENEDIAMINETETRA-ACETIC, SULPHA-SALICYLIC, AND AURINTRICARBOXYLIC ACIDS AND A NUMBER OF OTHER PREPARATIONS ON THE DISTRIBUTION OF Ce^{144} AND Y^{91}. Yu. I. Moskalev. Med. Radiol. 3, No. 6, 35-40(1958) Nov.-Dec. (In Russian)

The author presents a comparative analysis of the effect of yatren, atophan, euphylline, hexametaphosphate, as well as of sulphasalicylic, aurintricarboxylic and ethylenediaminetetraacetic acids and certain other preparations on the distribution and excretion of Ce^{144} and Y^{91}. It was established that hexametaphosphate is the most effective preparation for the acceleration of Ce excretion, while ethylenediaminetetraacetic acid for the acceleration of Y excretion. (tr-auth)

7420

THE EFFECT OF X-RAYS ON THE CYTOCHROME C. Z. I. Sheremet and M. O. Raushenbakh (Central Inst. of Hematology and Blood Transfusion, Ministry of Health, USSR). Med. Radiol. 3, No. 6, 40-6(1958) Nov.-Dec. (In Russian)

Irradiation of cytochrome C preparations with x rays (3500 r) did not cause any changes in their fermentative properties. The doses of 5000 r and over decreased the fermentative activity of cytochrome C preparations, the more so the greater the dose of irradiation. Irradiation of dogs with a lethal dose of x rays (800 r) had no effect on the fermentative properties of cytochrome C preparations, extracted from their hearts. X-rays irradiation of white rats in doses of 700 and 800 r did not decrease the content of cytochrome C in their organs. An insignificant rise in the amount of cytochrome C was noted in the heart in 1 to 3 days after the irradiation. With the progress of radiation sickness this rise was found to be slightly higher in the kidneys. Injections of cytochrome C in massive doses caused a slight pro-

longation of the life span (from 9 to 11.2 days) of white mice irradiated with lethal doses of x rays. (tr-auth)

7421

DISTURBANCE OF THE SUGAR-FIXATING FUNCTION IN POLONIUM AFFECTED ANIMALS. V. P. Fedotov. Med. Radiol. 3, No. 6, 46-50(1958) Nov.-Dec. (In Russian)

The sugar-fixating property of the liver was studied in dogs affected with polonium. Experiments were conducted on angiostomized dogs with cannulas in the portal and hepatic veins. Alimentary glucose loading was used to characterize the sugar-fixating function of the liver. It was established that the degree of sugar retention by the liver depends on its concentration in the blood flowing to the liver. In alimentary hyperglycemia of healthy animals liver retains about 21 to 22% of the additional sugar of the inflowing blood as compared to its initial level. The sugar-fixating function of the liver decreases during radiation sickness. At the terminal stage of the disease only 5 to 10% of the additional sugar is fixated by the liver. (tr-auth)

7422

TESTING OF CHOLINERGIC AGENTS IN THE PROPHYLAXIS OF RADIATION SICKNESS IN MAMMALS. L. F. Semenov (Inst. of Experimental Pathology and Therapy, Academy of Medical Sciences, USSR). Med. Radiol. 3, No. 6, 58-61(1958) Nov.-Dec. (In Russian)

Results are given from studies of cholingeric and cholinolytic agents for analysis of the mechanism of the prophylactic effect of acetylcholine. Experiments were performed on 2832 white mice irradiated with x rays in the dose of 700 r. The protective effect of acetylcholine mainly depends on its action on the M-cholinoreceptors. (tr-auth)

7423

EFFECTS OF X RAYS ON THE PRODUCTION OF AGGLUTININ IN GUINEA PIGS. L. G. Kovtunovich. Med. Radiol. 3, No. 6, 66(1958) Nov.-Dec. (In Russian)

Experiments were made with 62 guinea pigs in order to determine the effects of single whole-body exposure to 100 or 500 r on the production of typhoid agglutinins. A considerable depression of agglutinin production was observed only after the first vaccination. After repeated vaccinations, an increase in agglutinin level was observed in all irradiated animals regardless of the dose or length of exposure. (R.V.J.)

7424

PROTECTIVE EFFECTS OF PYRIMIDINE DERIVATIVES AGAINST X RAYS IN WHITE MICE. I. F. Grekh. Med. Radiol. 3, No. 6, 67(1958) Nov.-Dec. (In Russian)

The protective effects of pyrimidine derivatives on the resistance of white mice exposed to 500, 600, and 800 r were studied. (R.V.J.)

7425

EFFECTS OF UNITIOL ON EXCRETION OF Po^{210} FROM THE BODY. M. G. Zolotova. Med. Radiol. 3, No. 6, 67-8(1958) Nov.-Dec. (In Russian)

Experiments with 200 rats showed that small doses of unitiol (50 mg/kg) were ineffective in acute or chronical cases, while large doses (100 mg/kg) injected during early stages of the sickness prolonged survival time by a factor of 3 to 4. The early applications of large doses increased considerably the excretions of Po; the specific activity of urine increased 30 to 40 times and that of the feces 2 times in comparisons with control animals. (R.V.J.)

7426

THE INITIAL REACTION OF THE GENERAL RADIATION SYNDROME. C. G. Hunter (Univ. of Toronto). Med. Services J., (Canada) 14, 406-19(1958) June.

Available sources of information concerning the effects of radiation on man are reviewed. Data on the initial reaction in man are discussed in terms of time course, etiology, and therapy. The initial reaction in man and sub-human primates is characterized by a symptom-free period following irradiation, a period of symptomatic disturbance, and a recovery period. The effectiveness of various therapeutic measures during each period is discussed. 32 references. (C.H.)

7427

HYPOPHYSECTOMY, IRRADIATION, AND BIOSYNTHESIS OF HEPATIC LIPIDS. P. Paoletti and R. Paoletti (Univ. of Milan). Minerva nucleare 2, 341-3(1958) Nov. (In Italian)

The incorporation of acetate-1-C^{14} and mevalonate-2-C^{14} into cholesterol and the biosynthesis of fatty acids from acetate-1-C^{14} are greatly reduced in hypophysectomized rats. X irradiation has a clear stimulating effect on the incorporation of acetate-1-C^{14} and mevalonate-2-C^{14} into cholesterol in the livers of hypophysectomized rats. It is established that this effect of x irradiation is independent from hypophyseal control. (auth)

7428

EFFECT OF IRRADIATION ON THE INCORPORATION OF SOME PRECURSORS IN CHOLESTEROL AND IN SOME FATTY ACIDS. E. Grossi, P. Paoletti, and R. Paoletti (Univ. of Milan). Minerva nucleare 2, 343-6(1958) Nov. (In Italian)

Cholesterol and fatty acid biosynthesis after x irradiation (3750 r) from various labelled precursors (sodium acetate-1-C^{14}, sodium-n-butyrate-1-C^{14}, glucose-U-C^{14}, mevalonate-2-C^{14}) is studied in rat liver. The oxidation rate of the substrates used is not significantly influenced by x irradiation. Sodium acetate-1-C^{14} is incorporated 3 times more rapidly in cholesterol and 6 times more rapidly in fatty acids after irradiation than in control animals in the same experimental conditions. Sodium butyrate-1-C^{14} and glucose-U-C^{14} incorporation is not influenced. Mevalonate-2-C^{14} incorporation into cholesterol is increased about 4 times after irradiation; its incorporation into fatty acids, which is marked in normal conditions, is not influenced by x irradiation. The possible significance of these findings is discussed. (auth)

7429

THE IMPORTANCE OF ATOMIC ENERGY FOR THE IMPROVEMENT OF AGRICULTURE. R. A. Silow. Minerva nucleare 2, No. 11, IV-VII(1958) Nov. (In French)

A brief survey is made of the uses of nuclear energy in the improvement of agriculture. The topics discussed include electric energy in agriculture, radiation conservation of food, improvement of animal and plant stock by mutations, the use of isotopes in biological research, and the importance of agricultural research. (J.S.R.)

7430

MECHANISM OF RADIATION EFFECT ON THE PROCESS OF SYNTHESIS OF DEOXYRIBONUCLEIC ACID. L. G. Lajtha, R. Oliver, R. Berry, and W. D. Noyes (Univ. of Oxford). Nature 182, 1788-90(1958) Dec. 27.

Data are presented from an investigation of radiation

effects on the period of synthesis of desoxyribonucleic acid (S period). Human bone-marrow cell suspensions obtained by sternal puncture were used. For irradiation of the cultures, 300-kv radiation with a dose-rate to the cells of 480 rad/min was employed. Sodium formate labeled with carbon-14 was added to the medium as desoxyribonucleic acid label. The relative biological efficiency of α particles compared with x radiation was measured by dissolving radon gas in the medium in which the cells were suspended. For such irradiations, small culture bottles were used for cutting down the air space above the fluid. Within 30 min 500 to 5,000 rad could be delivered by the α particles to the cells; the radon gas was then removed by aeration, and the cell suspensions were transferred to the regular culture bottles for incubation with formate labeled with carbon-14. Synthesis of desoxyribonucleic acid was measured by the average grain count per labeled cell, or by the total radioactivity in 12×10^6 cells. The time relationship of depression of synthesis of desoxyribonucleic acid produced by a dose of 2,000 rad x rays is shown in graphic form. Also, a dose-response curve for x rays on synthesis of desoxyribonucleic acid during a 4-hr incubation period is included. (J.H.M.)

7431

INFLUENCE OF CYSTEAMINE ON THE TERATOGENIC ACTION OF X-RADIATION. D. H. M. Woollam and J. W. Millen (Univ. of Cambridge, Eng.). Nature 182, 1801(1958) Dec. 27.

Results of studies on pregnant mice indicate that the administration of cysteamine immediately prior to radiation exposure considerably mitigates the deleterious effects of x radiation on the developing fetus. Data are tabulated. Possible reaction mechanisms are discussed. (C.H.)

7432

REDUCTION IN THE LETHAL EFFECTS OF RADIATIONS ON ESCHERICHIA COLI B BY TREATMENT WITH CHLORAMPHENICOL. N. E. Gillies and Tikvah Alper (Hammersmith Hospital, London). Nature 183, 237-8(1959) Jan. 24.

The lethal effects of both x radiation and ultraviolet on E. coli were greatly reduced when the bacteria were incubated for a period after irradiation on a solid medium containing 5 μg/ml of chloramphenicol. The effect was enhanced when incubation was carried out under anoxic conditions. Survival was still further increased if the irradiation was followed by a preliminary period of one hour on nutrient agar before the chloramphenicol treatment. Results suggest that inhibition of some metabolic step, for a limited time after irradiation, might lead to increased survival of irradiated bacteria. (C.H.)

7433

DIFFERENTIAL RESPONSE OF MALE AND FEMALE ADULTS OF TROGODERMA GRANARIUM EVERTS TOWARDS STERLIZING DOSES OF GAMMA-RADIATION. G. C. Carney (King's Coll., Newcastle on Tyne, Eng.). Nature 183, 338-9(1959) Jan. 31.

Adults of Trogoderma granarium Everts were irradiated with sterilizing doses of γ radiation (administered from a cobalt-60 source at 570 r per min) to study the differential response of the male and female. Results show that a dose of 5×10^3 rads is sufficient to sterilize only the females of the species. The males are able to retain some fertility at dosages up to 15×10^3 rads, which is three times that required to sterilize the females. (J.H.M.)

7434

DOSE-RESPONSE RELATIONSHIP IN RADIATION LEUKAEMIA: THE MARKING PROBIT. D. J. Mewissen (Univ. of Liege). Nature 183, 401-2(1959) Feb. 7.

Statistical methods are applied in an analysis of data on radioinduced leukemia. It is concluded that available data do not provide statistical control of the best fit. (C.H.)

7435

INDUCTION OF LUNG TUMOURS BY RADIOACTIVE PARTICLES. Lewis A. Temple, D. H. Willard, S. Marks, and W. J. Bair (General Electric Co., Richland, Wash.). Nature 183, 408-9(1959) Feb. 7.

Data are tabulated on the incidence of pathological findings in the lungs of mice following the intratracheal administration of ruthenium-106 oxide and plutonium-239 oxide. Results are presented from gross and microscopic examinations, and estimates of the total dose to lung tissue are included. The mice were killed either 100 or 500 days after treatment. Pneumonitis and pulmonary papillary cystadenomas were observed, with a marked increase in histological effects observed after 350 to 500 days. Several malignant tumors were observed. (C.H.)

7436

THE EFFECT OF SMALL DOSES OF IONIZING RADIATIONS ON THE DEVELOPMENT OF EXPERIMENTAL LEUKAEMIA IN DOGS. M. S. Lapteva-Popova. Problems Hematol. Blood Transfusion (USSR) (English Translation) 3, 74-86(1958).

Following the daily exposure of dogs to small doses of x rays, a proportion of the animals developed leukaemia from 2.5 to 5 years after the beginning of irradiation. The diagnosis was established on the basis of changes in the peripheral blood and bone marrow. The most significant changes are in the white cell differential count and the myelogram. The number of leucocytes hardly varies. Obvious manifestations of the disease are preceded by delay of cell maturation and a large increase in the more immature forms in the bone marrow; and in the peripheral blood by the presence of immature bone marrow cells and a considerable number of erythroblasts, a rise in the number of basophils and sharp variations in the number of thrombocytes. (auth)

7437

RADIATION LESIONS OF THE LUNGS AND PLEURA IN X-RAY AND GAMMA-THERAPY OF MAMMARY CANCER. R. M. Rabinovich and A. V. Kantin (Central Radiological Research Inst., Moscow). Problems Oncol. (U.S.S.R.) (English Translation) 3, 711-18(1957).

Results are summarized from clinical and radiological examinations of the lungs during radiotherapy for mammary cancer. It was concluded that irradiation of the thorax with therapeutic doses of penetrating radiations may cause radiation damage to the lungs, which may take several forms. It is stressed that radiotherapy should be carried out under careful radiographical control and maximum protection of the thoracic organs. (C.H.)

7438

TEZAN 25 FOR THE PROPHYLAXIS AND TREATMENT OF RADIATION SICKNESS IN TUMOUR PATIENTS. A. A. Manevich and N. Ia. Trofimenko (Stalinsk Post-

graduate Medical School and Stalinsk City Oncological Dept., U.S.S.R.). Problems Oncol. (U.S.S.R.) (English Translation) 3, 724-8(1958).

Tezan 25 was found to be an effective drug for the prophylaxis and treatment of radiation sickness in tumor patients. Tezan 25 improved the general state of the patient, stimulated the depressed function of leukocytogenesis, and prevented or reduced the symptoms of intoxication by radiation. Tezan 25 is described as a white, sweet, crystalline powder, but no indication of its chemical nature is given. (C.H.)

7439

BIOLOGICAL DAMAGE IN DEVELOPING GERM CELLS OF DROSOPHILA VIRILIS IN OXYGEN AND NITROGEN WITH 14-Mev NEUTRONS. Mary L. Alexander (M. D. Anderson Hospital, Univ. of Texas, Houston and Oak Ridge National Lab., Tenn.). Proc. Natl. Acad. Sci. U. S. 44, 1217-28(1958) Dec.

Germ cells of Drosophila were exposed in spermatogenesis with 14-Mev accelerator neutrons in oxygen and nitrogen atmospheres. Biological damage was compared in sperm, spermatids, and meiotic and spermatogonial germ cells. (C.H.)

7440

Pb^{212}(ThB) TRACER STUDIES IN ADULT BEAGLE DOGS. Betsy J. Stover (Univ. of Utah, Salt Lake City). Proc. Soc. Exptl. Biol. Med. 100, 269-72(1959) Feb.

Metabolism of short-lived Pb^{212} has been studied following intravenous injection to beagles, and after transfusion of blood cells tagged with Pb^{212} in vitro. The latter proved to be a satisfactory method to determine blood volume. When Pb^{212} was given intravenously, in vivo, tagging of blood cells occurred. A maximum of 65% of the activity in cells was reached at 2 to 3 hours after injection, then Pb^{212} in blood cells decreased with a biological $t_{½}$ = 37 hours and an effective $t_{½}$ = 8.2 hours. The same decrease occurred after injection of in vitro tagged cells. In both experiments essentially all Pb^{212} decayed inside the dog. Half decayed in blood in the in vivo tagging experiment; 4/5 decayed in blood when tagging was done in vitro. (auth)

7441

IN VIVO MEASUREMENT OF RADIOPHOSPHORUS AND RADIOSTRONTIUM ABSORPTION IN RATS. Carl F. Cramer (Univ. of British Columbia, Vancouver, Can.). Proc. Soc. Exptl. Biol. Med. 100, 364-7(1959) Feb.

An in vivo method has been described for studying radiophosphorus and radiostrontium absorption from the intestinal tract in rats. The method is simple, avoids surgical trauma, and permits visualization of the absorption process in individual animals. Rate of absorption at various times may also be estimated. This is not possible with the standard balance studies. Anesthesia is not necessary, though no difference of Sr^{89} absorption was found when anesthesia was used. Absorption of radiophosphorus was very rapid, reaching a peak at 30 minutes. In most animals, there was a delay of 20 to 30 minutes before significant amounts of radiostrontium were absorbed, and the whole process was slower. It was possible to measure radiostrontium absorption on two different occasions in the same animal, first with Sr^{89} and then with Sr^{85}. This should prove of value in studying factors affecting strontium absorption. (auth)

7442

EFFECT OF CONTINUOUS LOW DOSE GAMMA IRRADIATION ON BACTERICIDAL ACTIVITY OF PHAGOCYTIC CELLS OF MICE. Eric L. Nelson and Joan R. Becker (Univ. of Chicago). Proc. Soc. Exptl. Biol. Med. 100, 387-8(1959) Feb.

Mice were subjected to continuous gamma radiation (128 r/22 hours) for 3 weeks, and bactericidal activity of their phagocytes determined at weekly intervals. Bactericidal activity declined gradually through 2 weeks exposure (1800 r) then fell off rapidly in the third week (2695 r). These results are compared to those obtained with mice exposed to single doses of x irradiation. (auth)

7443

EFFECT OF FOREIGN FETAL AND NEWBORN BLOOD-FORMING TISSUES ON SURVIVAL OF LETHALLY IRRADIATED MICE. I. S. Urso, C. C. Congdon, and R. D. Owen (Oak Ridge National Lab., Tenn.). Proc. Soc. Exptl. Biol. Med. 100, 395-9(1959) Feb.

Lethally irradiated mice that received blood-forming cells from homologous fetal liver showed better long-term survival and lymphatic tissue recovery than those treated with blood-forming cells from adult homologous bone marrow. In both cases there was transplantation and persistence of erythropoietic cells. (auth)

7444

PERSISTENCE OF HETEROLOGOUS BONE MARROW IN MICE AS FUNCTION OF X-RAY DOSE. Isabel C. Shekarchi and Takashi Makinodan (Oak Ridge National Lab., Tenn.). Proc. Soc. Exptl. Biol. Med. 100, 414-17(1959) Feb.

Bone marrow from species closely and distantly related to the mouse was injected after various x-ray doses to the total body. Rat, hamster, guinea pig, and rabbit bone marrow persisted in normal, nonirradiated mice for not more than 1 day. The minimum x-ray dose that would permit persistence of rat, hamster, guinea pig, and rabbit bone marrow in mice for more than 3 days was 400, 600, 1150, and 1500 r, respectively. The minimum x-ray dose that permitted temporary transplantation of rat and hamster bone marrow in mice was 500 and 600 r, respectively, and prolonged transplantation of rat and hamster bone marrow in mice was 800 and 950 r, respectively. The significance of these findings is discussed. (auth)

7445

EFFECTS OF IMMUNIZED PARENTAL STRAIN BONE MARROW ON LETHALLY IRRADIATED F_1 HYBRID MICE. G. E. Cosgrove, Jr., A. C. Upton, E. E. Schwartz, C. C. Congdon, and T. Makinodan (Oak Ridge National Lab., Tenn.). Proc. Soc. Exptl. Biol. Med. 100, 417-20(1959) Feb.

Pre-sensitization of parental strain donor mice against F_1 hybrid recipients accentuated the foreign bone marrow reaction caused by injection of parental marrow cells into lethally irradiated F_1 recipients. This effect occurred with use of parental strains (101 and C3H) that were histocompatible at the H-2 locus, as well as with those (C57BL and 101) that were histoincompatible at this locus. These results are interpreted to indicate the importance of relative antibody-forming potency of implanted cells, as well as the extent of histocompatibility differences in pathogenesis of the homograft reaction. (auth)

7446

THE EFFECT OF HIGH DOSES OF RADIATION ON SEEDLING GROWTH. M. A. Sicard and Drew Schwarts (Oak Ridge National Lab., Tenn.). Radiation Research 10 1-5(1959) Jan.

Further studies on the phenomenon of reversal in the seedling height-dose curve are reported. A comparison of the coleoptile and leaf growth in barley and wheat lends support to the postulate that the reversal is caused by an interaction of chromosome damage and mitotic inhibition. In corn, the phenomenon persisted even after a postirradiation storage of the seeds for more than 4 years. The dose at which the reversal occurs was shown to be dependent on the moisture content of the seed at the time of irradiation. With superdry seeds, which show increased radiosensitivity as compared to air-dry seeds, the reversal occurs at a lower dose. (auth)

7447

NONIONIZING RADIANT ENERGY AS AN AGENT IN ALTERING THE INCIDENCE OF X-RAY-INDUCED CHROMATID ABERRATIONS. II. REVERSAL OF THE FAR-RED POTENTIATING EFFECT IN VICIA BY RED RADIANT ENERGY. C. C. Moh and R. B. Withrow (Smithsonian Institution, Washington). Radiation Research 10, 13-19(1959) Jan.

Far-red radiant energy given in a waveband from 715 to 940 mμ, with an irradiance of 3000 $\mu w/cm^2$, was capable of inducing a potentiating effect on chromatid aberrations in Vicia root tips induced by 100 to 120 r of x rays. When red energy from 620 to 680 mμ, at an irradiance of 300 $\mu w/cm^2$, was applied for 3 hours either simultaneously with or immediately after the far-red treatment, no increase in frequency was obtained. These results indicate that the red is capable of nullifying or reversing the far-red potentiating effect. Apparently, the red, far-red reversible system, which has been demonstrated in a wide variety of systems in higher plants, also occurs at the nuclear level. (auth)

7448

EFFECTS OF HEAVY PARTICLE IRRADIATION ON ACUTE MORTALITY AND SURVIVAL TIME IN THE MOUSE. V. P. Bond and O. D. Easterday (Brookhaven National Lab., Upton, N. Y.). Radiation Research 10, 20-9(1959) Jan.

The 28-day mortality rate was determined for female CF1 mice given B^{10}-enriched borax or Li^6-enriched LiCl intravenously and exposed 5 minutes later to graded doses of total-body thermal neutron radiation. The LD_{50} values were as follows: 25 μg of B^{10} per gram, $1.30 \pm 0.11 \times 10^{12}$ n/cm²; 33.3 μg of Li^6 per gram, $0.84 \pm 0.04 \times 10^{12}$ n/cm²; thermal neutrons alone, $4.77 \pm 0.14 \times 10^{12}$ n/cm; and cobalt-60 γ-radiation, 789 ± 30 r. The RBE for the heavy particles (α and Li^7) from B^{10} neutron capture was calculated to be 2.0; a value of 3.2 was obtained for the particles (α and tritium) from Li^6 neutron capture. The tendency to 3- and 4-day deaths was found to be much more pronounced in animals exposed to heavy particle irradiation as compared to those exposed to x-ray, γ, fast neutron, or thermal neutron irradiation. (auth)

7449

THE EFFECT OF IONIZING RADIATIONS ON CARBOHYDRATES. M. L. Wolfrom, W. W. Binkley, L. J. McCabe, T. M. Shen Han, and A. M. Michelakis (Ohio State Univ., Columbus). Radiation Research 10, 37-47 (1959) Jan.

Selected carbohydrates underwent color and organoleptic changes on irradiation in the solid state. On irradiation in aqueous solution, a selective oxidation of the terminal primary hydroxyl groups of D-glucitol (sorbitol) and D-mannitol occurred, with the formation of glucose and gulose from the former and of D-mannose (isolated as β-D-mannopyranose pentaacetate) from the latter. Arabinose and xylose (from D-glucitol) and arabinose alone (from D-mannitol) were also formed, and at high doses D-mannitol yielded mannuronic acid. These changes were established by paper chromatographic methods. D-Glucose and D-fructose (especially) undergo radiation damage in aqueous solution. Irradiation of the disaccharides sucrose, maltose, and cellobiose, and the trisaccharide raffinose, demonstrated that the glycosidic bond is especially sensitive to the action of ionizing radiations and that the order of hydrolysis is qualitatively that found with acid hydrolysis. Hydrolysis of the disaccharides and trisaccharides increased with increasing irradiation dosage. (auth)

7450

CERTAIN MORPHOLOGICAL AND BIOCHEMICAL CHANGES IN GAMMA-IRRADIATED CARROTS (DAUCUS CAROTA L.) AND POTATOES (SOLANUM TUBEROSUM L.). K. A. Madsen, D. K. Salunkhe, and M. Simon (Utah State Univ., Logan and Container Inst. for the Armed Forces, Chicago). Radiation Research 10, 48-62(1959) Jan.

Experiments were conducted to study the effects of γ radiation (dose and rate) and preradiation thermal treatments on morphological, chemical, histological, and taste quality changes in carrots and potatoes. The results and observations are summarized. (auth)

7451

THE EFFECT OF INTERNAL EMITTERS ON RED CELL SURVIVAL IN BEAGLE DOGS. John E. Parkinson (Univ. of Utah, Salt Lake City). Radiation Research 10, 63-6(1959) Jan.

The time for reduction in survival of red cells to 50% of normal beagle dogs in this study (20 to 32 days) compares closely with that of normal mongrel dogs (21 to 30 days). There was no definite hemolytic component as indicated by Cr^{51}-labeled red-cell studies in the anemia secondary to internal irradiation in beagle dogs. Slight damage to red cells is suggested, however, by the fact that survivals for many of the anemic irradiated dogs fell into the low normal range. Evidence for red-cell damage with shortening of the Cr^{51} red-cell survival time has been found in dogs subjected to external x radiation. Two control dogs with pooled data appeared to fit a formula of postulated red-cell destruction. (auth)

7452

PROCEEDINGS OF THE INTERNATIONAL CONGRESS OF RADIATION RESEARCH, BURLINGTON, VERMONT, U.S.A., AUGUST 11-15, 1958. Douglas E. Smith, ed. Radiation Research Suppl. I, 1-582(1959).

The present status of radiation research is reviewed. Topics discussed in detail include: the role of oxygen and peroxides in radiation chemistry; late effects of irradiation in mammals; the correlation of various radiobiological actions on yeast; induced changes in DNA and in chromosome structure; free radicals produced by irradiation; and elementary physical processes involved in radiobiological responses. Discussions and author and subject indexes are included. 1534 references. (C.H.)

7453

FACTORS WHICH INFLUENCE THE LATENT IMAGE IN AUTORADIOGRAPHY. Edgar A. Tonna (Hospital for Special Surgery, New York) and Eugene P. Cronkite (Brookhaven National Lab., Upton, N. Y.). Stain Technol. 33, No. 6, 255-60(1958) Nov.

Sections treated with N-ethyl-maleimide, a sulfhydryl blocking reagent, exhibit similar grain counts over nonradioactive and S^{35}-labeled tissues. This reveals that no chemographic effects were produced by sulfhydryl groups in tissues fixed and prepared in the manner described. It was noted, however, that background count over tissue sections is consistently lower than over adjacent film, indicating perhaps the existence of substances in tissues which interfere with the production of the latent image. These effects have been eliminated by coating the tissues with celloidin. Celloidin coating can be used for most emitters including S^{35} but not for tritium. A special method for tritium, not involving celloidin coating is given. (auth)

7454

QUANTITATIVE EVALUATION OF AUTO-INFECTION IN RADIATION DISEASE. R. V. Petrov. Vestnik Rentgenol. i Radiol. 32, No. 1, 3-8(1957) Jan.-Feb. (In Russian)

In whole-body irradiation by 600 r the period of sterility lasting one day is followed by a bacteremic period characterized by the appearance of a small quantity of microbes in the blood and a considerably greater amount in the spleen. This condition lasts from 3 to 7 days and may be called the period of relative compensation of protective mechanisms. The last days (8 to 10) of the animal's life are characterized by a sharp rise in microbes both in the organs and in the blood. (R.V.J.)

7455

EFFECTS OF X-RAY IRRADIATION ON THE TRANSMISSIBLE VENEREAL TUMOR OF THE DOG. Masaski Hataya, Yasuhiko Shirasu, and Akira Takeuchi (Univ. of Tokyo). Gann 49, 307-18(1958) Dec.

The response of the transmissible venereal tumor of dogs to x-ray irradiation has been studied. Tumors of eight female dogs, in the vaginal wall adjacent to the labia, disappeared completely following radiation therapy given in six exposures of 200, 300, or 400 r over a period of three weeks (1200 to 2400 r total dose). From the results obtained it is concluded that the transmissible venereal tumor of the dog is sensitive to irradiation. Histological studies revealed transient suppression of mitosis, cellular and nuclear enlargement and mitotic aberrations in the earlier stages of treatment. In the advanced stages of tumor regression, nuclear disintegration, infiltration with granulocytes, lymphoid cells, histiocytes, and plasma cells followed by proliferation of fibrous tissue were observed. Both clinical and hematological observations indicate that the irradiation therapy was well tolerated. (auth)

7456

INVESTIGATIONS MATERIAL TO THE SPECIFICITY OF RESPONSES OF AN ORGANISM TO IRRADIATION. M. P. Domshlak, G. A. Avrunina, Yu. G. Grigorev, and N. G. Darienskaya. Vestnik Rentgenol. i Radiol. 32, No. 2, 3-10(1957) Mar.-Apr. (In Russian)

An attempt is made to show the significance of quantitative analysis for investigating the problem and to appraise the influence exerted by the space distribution and time of irradiation on the specific peculiarities of an organism's responses to irradiation. Comparison is made between experimental findings on the efficiency of similarly timed internal and external irradiations. Clinical and physiological observations are cited referring to peculiarities of responses in the central nervous system, depending on whether the influence of penetrating irradiation on this system is direct or indirect. Experimental data characterize the dependence of the response on the irradiated area. (tr-auth)

7457

AN ATTEMPT TO PRODUCE A RELAPSE OF RADIATION SICKNESS. V. N. Vorob'ev (Kirov State Univ. for Graduate Work in Medicine). Vestnik Rentgenol. i Radiol. 32, No. 3, 3-5(1957) May-June. (In Russian)

An attempt was made to produce by means of a second trauma a relapse in guinea pigs which had just recovered from acute radiation sickness. Acute radiation sickness of the 2nd or 3rd degree was produced in 36 animals by a single x-ray irradiation. It was accompanied by a reduction in the number of leucocytes to 200 to 400 per 1 mm^3 and a reduction in weight of 15 to 20%. In 9 to 14 days, 50% of the animals perished. On the 40th day after the irradiation, after they had clinically recovered (the amount of leucocytes was up to normal and their general condition was good), a closed fracture of the femur (the second trauma) was produced in the 18 surviving guinea pigs without anesthesia or immobilization. A careful observation of the animals was conducted after the traumas were inflicted. During ten days no changes in blood or general conditions were observed. These animals endured the traumas in the same manner as five nonirradiated control guinea pigs with the same traumas. (tr-auth)

7458

THE INFLUENCE OF IONIZING RADIATION ON HEMOLYSIS OF ERYTHROCYTES. A. P. Belousov (Molotov State Scientific Research Inst. of Roentgenology and Radiology). Vestnik Rentgenol. i Radiol. 32, No. 3, 5-14(1957) May-June. (In Russian)

The resistance of red blood cells to saponine hemolysis in radiation disease of rabbits and in irradiation of blood was studied. Irradiation of rabbits with a dose of 700 r causes rapid disappearance of low-resistant red blood cells from the blood and the formation of red blood cells resistant to chemical hemolysis. Accompanying lesions temporarily increase red blood cell decomposition. In rabbits irradiated with 1000 to 1300 r intensive red blood cells hemolysis began immediately and continued for up to 30 days. The appearance of resistant erythrocytes in the blood precedes active hemopoiesis and hemoglobin reparation. Increased resistance of red blood cells to saponine hemolysis is observed after blood loss and subsequent irradiation of the animals. Irradiation of the blood in vitro by large doses of ionizing radiation, in contrast to minor doses, lowers the resistance of red blood cells to chemical hemolysis. The discovered laws of red blood cell hemolysis under ionizing radiation permit the development of protective means against the lesion in question. (tr-auth)

7459

SOME DATA ON THE LYMPHATIC SYSTEM CHANGE IN ACUTE RADIATION SICKNESS. A. N. Kishkovskii (Kirov Military-Medical Academy). Vestnik Rentgenol. Radiol. No. 6, 80-1(1958). (In Russian)

Some 332 experiments were made with 59 rabbits ex-

posed to whole-body irradiation at 2000, 1250, 1000, 800, and 300 r. The data showed that in all cases radiation injuries were accompanied by explicit disturbance in the morphology and function of the lymphatic system. (R.V.J.)

7460

RADIOBIOLOGY OF THE NEWT, DIEMICTYLUS VIRIDESCENS. HEMATOLOGICAL AND HISTOLOGICAL EFFECTS OF WHOLE-BODY X IRRADIATION. Sophie Jakowska, Ross F. Nigrelli, and Arnold H. Sparrow (Coll. of Mount St. Vincent; N. Y. Zoological Society; and Brookhaven National Lab.). Zoologica 43, Pt. 4, 155-60(1958) Dec. 31.

Adult newts, Diemictylus viridescens, were relatively resistant to high doses of x irradiation, surviving for up to five months following exposure to 9000 r when kept at 5°C after x-ray treatment. At room temperature of 22 to 23°C, the LD 50/30 days was found to be 1486 r. There was no appreciable effect on the blood elements of the peripheral circulation, although there was extensive damage to the hemopoietic organs (erythrocyte- and thrombocyte-forming spleen and granulocyte-forming layer of the liver). No bacteremia was found at any stage and irradiated newts showed the ability to ward off experimental infection by active phagocytosis. The above may be related to the radioresistance of this species. It is assumed that death was due to the destruction of the osmo-regulatory functions in organs such as the kidney, lungs, and skin. (auth)

7461

PROTOPLASMATOLOGIA. HANDBUCH DER PROTOPLASMAFORSCHUNG. BAND X. PATHOLOGIE DES PROTOPLASMAS. 3. EFFETS BIOLOGIQUES DES RADIATIONS. ASPECTS BIOCHIMIQUES. (Protoplasmatology. Handbook of Protoplasm Research. Volume X. Pathology of Protoplasm. 3. Biological Effects of Radiations. Biochemical Aspects). Maurice Errera. Vienna, Springer-Verlag, 1957. 244p.

A review is presented of the work done on the biological effects of radiation. The subjects discussed include radiation effects on cellular constituents, metabolism of glucides, lipides, and proteins, structure and metabolism of nucleic acids, nuclear and cytoplasmic effects, and modifications of radiation effects. 1081 references. (J.S.R.)

7462

PROCEEDINGS OF THE SYMPOSIUM ON TRITIUM IN TRACER APPLICATIONS. Boston, New England Nuclear Corp., 1957. 43p.

Information is presented on the advantages and disadvantages of radioactive tracing with tritium. Discussions are included on: methods for tritium labeling of organic compounds, liquid scintillation and gas counting of tritium, health physics considerations, uses of tritium-labeled compounds in pharmaceutical research, developments in the use of radioisotopes in reservoir engineering, tritium in biochemical studies, and autoradiography with tritium. (J.H.M.)

7463

NUCLEAR RADIATION IN FOOD AND AGRICULTURE. W. Ralph Singleton, ed. Princeton, N. J., D. Van Nostrand Company, Inc., 1958. 387p.

The chapters in this book are based on papers selected from those presented at the Conference on Peaceful Uses of Atomic Energy held in Geneva, Switzerland, in August 1955. Selection was exercised not only in the individual papers chosen but also in the topics. Topics covered include: the general use of radioisotopes in agriculture; the biosynthesis of carbon-14-labeled plants; photosynthesis; plant physiology, pathology, and cytology; the stimulation of plant growth with ionizing radiation; root grafting; foliar absorption by plants; the uptake of minerals; tracing fungicidal actions; the effects of continuous gamma exposure on plant growth; cytological and chemical effects of radiation in plants; the use of radioisotopes in soil and fertilizer studies; genetic and biological hazards of nuclear radiation; the eradication of the screw-worm fly in the island of Curacao by the use of ionizing radiation; uses of radiation in plant breeding programs; and applications of radiation in food sterilization and preservation. 504 references. (C.H.)

CHEMISTRY

General

Refer also to abstracts 8352, 8353, 8359, 8376, 8378, 8386, 8387, 8388, 8390, 8392, 8396, 8404, 8405, 8421, 8422, 8428, 8432, 8447, and 8455.

7464 A/CONF.15/P/1611

DESIGN OF THE FINAL STAGES OF DEUTERIUM PRODUCING PLANTS. Y. Lehrer and Y. Weissman (Israel Atomic Energy Commission). 27p.

It is recognized today that the optimum plant for the production of heavy water should utilize different processes for the initial and the final stages of the enrichment. For the final stages, the distillation of water seems to be favored. A design of a final enrichment section (15 to 99.8% D_2O) of a plant of 50 tons/year capacity is described. The design is based on the use of packed columns. Dimensions and approximate cost estimates are given. (auth)

7465 A/CONF.15/P/1628

THE NUCLEAR MAGNETIC MOMENT AS A TOOL FOR DETECTION, ANALYSIS AND STRUCTURE OF CHEMICAL COMPOUNDS. S. S. Dharmatti, C. R. Kanekar, and S. C. Mathur (Tata Inst. of Fundamental Research, Bombay and Atomic Energy Establishment, Trombay, India). 18p.

Some experiments are reported that were carried out to test the suitability of the technique of nuclear magnetic resonance to the study of chemical problems such as the detection, analysis, and structure of chemical compounds. Large chemical shifts were observed in mercurous and mercuric compounds and the shifts observed can be used to identify the mercurous and mercuric ions. The shifts can also be correlated with the electronegativity of the atoms bonded to mercury and to the symmetry of the molecules which usually contributes to the second order para-magnetism independent of temperature. The shifts observed are quite large in comparison with those observed for other nuclei. Even larger chemical shifts were observed for a number of cobalt compounds. In compounds in which cis-trans isomerism occurs, two resonances of Co^{59} were observed and verified to be the chemical shifts. The nuclear magnetic resonance spectrometer is sensitive enough to detect deuterium in ordinary water in which

its abundance is about 2 parts in 10000. Some experiments carried out have shown that this sensitivity is good enough for the analysis of D_2O in natural water samples. A few samples have been investigated and it has been possible to compare their D_2O contents. (auth)

7466 A/CONF.15/P/2250
NON DISPERSIVE INFRA-RED ANALYSIS OF MIXTURES OF WATER AND HEAVY WATER. C. A. Bosselaar (Stichting voor Fundamenteel Onderzoek der Materie, Utrecht). 7p.

The deuterium content of mixtures of water and heavy water can be determined by means of a nondispersive infrared gas analyzer. An apparatus is described to measure D_2O content in vapor mixtures from the natural concentration range to 40% D_2O with an accuracy of about 0.5% D_2O. Much better results can be achieved with liquid mixtures. The method is suitable for rapid determinations on flowing streams of water. (W.D.M.)

7467 A/CONF.15/P/2325
CHEMISTRY, PHYSICS AND NUCLEAR PROPERTIES OF A NEW DEUTERATED BERYLLIUM COMPLEX TO BE USED AS A MODERATOR. M. A. Rollier (Univ. of Cagliari, Sardinia). 17p.

The theoretical values of the nuclear parameters of a new moderating material are discussed. The chemical synthesis of this deuterated beryllium complex is described, and the limits of its applications in research and power reactors are sketched. Radiation damage experiments on the new material are under way and their significance is appraised. (auth)

7468 AECU-3962(Pt. III)
Michigan. Univ., Ann Arbor.
THE FARADAIC ADMITTANCE OF ELECTROCHEMICAL PROCESSES. III. EXPERIMENTAL TEST OF THE THEORETICAL EQUATIONS. Report No. 44. Henry H. Bauer, David L. Smith, and Philip J. Elving. Aug. 14, 1958. 26p. Contract AT(11-1)-70, Project 8. $4.80(ph), $2.70(mf) OTS.

An evaluation of the two sets of equations obtained to describe the behavior of a simple redox reaction under the influence of a small superposed alternating potential is presented. The cadmium system was investigated under a variety of conditions. While either set of equations may be applicable to results for a particular system involving fixed concentration of depolarizer and background medium, neither set is of general applicability, e.g., neither describes satisfactorily the variation of the phase angle with frequency and that of the heterogeneous rate constant with frequency and depolarizer concentration. The difficulties seem to be associated with the use of invalid postulates in setting up the theories which led to the equations. It appears that explicit consideration should be given to the rectifying properties of electrodes in formulating the theories. (auth)

7469 AECU-3968
Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.
A RELATION BETWEEN PROTIUM–TRITIUM AND PROTIUM–DEUTERIUM ISOTOPE EFFECTS. C. Gardner Swain and Lawrence J. Schaad. 1958. 11p. Contract AT(30-1)-905. (AD-150493). $3.30(ph OTS); $2.40(mf OTS).

A relation between the isotope effects of tritium and deuterium was derived. In addition, the equations were experimentally tested by a system where isotope effects are large and accurately measurable. The deuterium isotope effect was 5.02, from which the calculated tritium isotope effect is 11.8 maximum, 10.7 high temperature limit, 10.2 low temperature limit, and 9.7 minimum. The observed tritium isotope effect was 10.2, well within the total range, and closest to the low-temperature limit. (J.R.D.)

7470 AECU-3977
Oregon. Univ., Eugene.
KINETICS OF AQUEOUS OXIDATION OF TANTALUM FROM CHRONOPOTENTIOMETRIC MEASUREMENTS. George B. Adams, Jr. and Eugene Y. K. Mak. [1958]. 19p. Contract [AT(45-1)-535]. $4.80(ph), $2.70(mf) OTS.

Theoretical mechanisms and growth laws for the initial oxidation of metals are briefly reviewed. The oxidation of tantalum was studied chronopotentiometrically at temperatures between 0 and 40°C in an oxygen-free electrolyte. The probable rate determining steps for the two different growth laws observed are deduced by comparison of the time dependence of the experimentally determined local oxidation current to theoretical local current-time functions derived from assumed growth laws. Tantalum oxidizes initially according to a direct logarithmic law, the slow step being tunneling of electrons through the oxide film. At 40°C a transition from a direct logarithmic to a parabolic growth law is observed. The interpretation is that the diffusion of electrons which have been injected thermionically into the oxide film becomes rate determining at film thicknesses for which current due to electron tunneling becomes negligible. (auth)

7471 AECU-3999
Michigan. Univ., Ann Arbor.
POLAROGRAPHY IN ORGANIC ANALYSIS. Report No. 45. Philip J. Elving. Jan. 10, 1959. 32p. Project No. 8. Contract AT(11-1)-70. $6.30(ph), $3.00(mf) OTS.

The discussion attempts to summarize present trends and future possibilities. After consideration of the areas of analytical applicability of polarography of organic compounds with stress on the use of chemical treatment to convert polarographically inert species to active ones, the importance of the composition of the test solution is discussed from the viewpoint of the effects of pH, buffer composition and concentration, ionic strength, solvent nature and additives. The critical factors in the preparation of the test solution and in the analysis of the polarographic curve are then considered. The importance of fundamental studies of the electrochemical behavior of organic compounds is stressed. (auth)

7472 AECU-4006
Broadview Research Corp., Burlingame, Calif.
AN INVESTIGATION OF THE REACTION BETWEEN HOT MOLYBDENUM AND LIQUID OXYGEN. Final Report. T. C. Goodale, B. Ragent, A. Samuels, and N. R. Wallace. July 1958. 36p. For Martin Co. Contract AT(30-3)-217, Subcontract PO-8E-0053. (RD-58-1.1035-8). $6.30(ph), $3.00(mf) OTS.

Cylindrical molybdenum samples 0.05 in. diameter by 5 in. long, 0.10 in. diameter by 5 in. long, 0.375 in. diameter by 4 in. long, and 1.75 in. diameter by 3 in. long were heated in inert atmospheres to various temperatures up to 2290°F and plunged into liquid oxygen. All samples heated to temperatures below 1600°F quenched with substantially no weight loss. For higher temperatures, samples up to 0.375 in. diameter behaved differently than the larger samples, in that once ignited they burned until completely consumed. Samples of

1.75 in. diameter failed to support combustion even when heated to 2100°F. These larger samples quenched after a small percentage weight loss. Small molybdenum bars, 2 by 5 by 40 mm protected by an inert metallic coating ignited occasionally in liquid oxygen when heated above the melting point of the coating (approximately 1950°F). Larger partially coated cylindrical samples 1.75 in. diameter by 3 in. long quenched in liquid oxygen after a small amount of reaction which was approximately proportional to the area of molybdenum exposed. (auth)

7473 AERE-C/M-369

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

SYNERGISM IN THE SOLVENT EXTRACTION OF URANIUM: A TENTATIVE EXPLANATION. J. Kennedy. Dec. 1958. 4p. $0.16(BIS).

Suggestions were made to account for the enhanced extraction of uranium by the dimeric acidic dialkyl phosphates $(HX)_2$ in the presence of nonionic phosphorylated reagents. Extraction which in the absence of the nonionic reagents occurs via the mechanism. $UO_2^{2+} + 2(HX)_2 \rightleftharpoons UO_2X_2 \cdot 2HX + 2H^+$ may be enhanced in their presence as a result of obviating the necessity of monomerizing a mole of the dimeric extractant. With TBP the suggested extraction mechanism is $UO_2^{2+} + (HX)_2 + 2TBP \rightleftharpoons UO_2X_2 \cdot 2TBP + 2H^+$. (auth)

7474 AERE-CE/M-74(Del.)

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

PREPARATION OF HAFNIUM-FREE ZIRCONIUM. J. M. Hutcheon and B. Longstaff. Oct. 28, 1953. Decl. with deletions Feb. 3, 1959. 10p.

A T.B.P. process for preparing hafnium-free zirconium has been worked out. Countercurrent batch extractions have been performed and four runs carried out in a 1-in. diameter pulsed packed column. Analytical data, as well as tracer measurements, are available for two of these runs, and indicate that hafnium contents of 0.01% and yields better than 95% can be obtained. (auth)

7475 AERE-CE/R-2471

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE HORIZONTAL AIR-PULSED COLUMN—A NEW LIQUID-LIQUID CONTACTOR FOR RADIOACTIVE PROCESSING. J. D. Thornton. Jan. 1958. Decl. Jan. 26, 1959. 8p. (DCPWP-P-102; CPDC-P-217; IGC-B-205WP/P21).

A new type of horizontal pulsed column is described which has been developed recently at A.E.R.E. Harwell. Preliminary work carried out with the water—toluene—acetone system has shown the extraction efficiency of the unit to be comparable with that of the conventional vertical type of pulsed column. The contactor is extremely simple mechanically and it is recommended that further development work be carried out in order to optimize the contactor geometry and to determine the extraction efficiency of the unit using a uranium system. This type of extractor should be considered for future processing applications where the headroom is limited and the use of air-pulsed columns is impracticable. (auth)

7476 BNL-3368

Brookhaven National Lab., Upton, N. Y.

FISSION PRODUCT CONCENTRATIONS IN FLUID REACTOR FUELS WITH CONTINUOUS PROCESSING. Allen M. Eshaya. 1956. 10p. $1.80(ph OTS); $1.80 (mf OTS).

The mathematical relationships relating the concentrations of fission products to the rates of removal were derived by Dwyer on the basis that no nuclide changes concentration as the fuel goes through the cycle. This analysis takes into account the changes in concentration which occur in a given volume element of fuel as it proceeds through the cycle. The relationship between the removal rates of successive nuclides in a given chain is introduced as a parameter. (A.C.)

7477 CCC-454-TR-300

Callery Chemical Co., Penna.

SOLUBILITY OF DIBORANE IN n-PENTANE AND IN n-BUTANE. J. W. Reed and J. F. Masi—S. L. Harvey, ed. Sept. 30, 1958. 13p. Project ZIP. Contract NOa(s)-58-454-d.

The solubility of diborane in n-pentane and in n-butane was measured over the temperature range −30 to 0°C at pressures from 0 to 8 atmospheres absolute. The Henry's law constants (expressed as mole fraction diborane per atmosphere) for diborane in n-pentane are 0.0382, 0.0459, 0.0552 and 0.0706 at 0°, −10°, −20°, and −30°C, respectively. The constants for diborane in n-butane are 0.0484, 0.0587, and 0.0736 at −10°, −20°, and −30°C, respectively. (auth)

7478 CF-59-1-101

Oak Ridge National Lab., Tenn.

CONTROL OF THORIUM OXIDE PARTICLE SIZE. K. O. Johnsson and C. V. Ellison. Jan. 22, 1959. 4p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

By carefully controlling the agitation, temperature, concentrations, and reagent addition rate, it was possible to produce a thorium oxide product within 0.3 μ of any selected size between 2.0 and 3.0 μ. The rate of addition of oxalic acid to a thorium nitrate solution was the variable used in the current series of tests. (auth)

7479 HW-58022

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

OXIDATION OF URANIUM IN AIR AT HIGH TEMPERATURES. R. K. Hilliard. Dec. 10, 1958. 31p. Contract W-31-109-Eng-52. $1.00(OTS).

The reaction between metallic uranium and air was investigated at temperatures ranging from 300 to 1440°C. The effect on oxidation rate of time, furnace temperature, area/weight ratio, and air flow rate was determined and the results presented graphically. The extent of self-heating due to the exothermic reaction was measured by recording both specimen and furnace temperatures. The time required for complete oxidation of cylindrical specimens was estimated and correlated as a function of furnace temperature and area/weight ratio. (auth)

7480 IGO-AM/W-76

United Kingdom Atomic Energy Authority. Industrial Group. Windscale Works, Sellafield, Cumb., England.

THE DETERMINATION OF MOISTURE IN GASEOUS CARBON DIOXIDE UNDER PRESSURE (ABSORPTION IN ANHYDRONE). Feb. 14, 1957. 4p.

A measured volume of the gas is passed through tared absorption tubes containing magnesium perchlorate which are subsequently re-weighed. The method is suitable for the determination of moisture in carbon dioxide under pressure and is designed for use on the

feed gas and the coolant of nuclear reactors of the Calder type. (auth)

7481 IGR-R/CA-200

United Kingdom Atomic Energy Authority. Industrial Group. Capenhurst Works, Capenhurst, Ches., England.

THE REACTIONS OF SODIUM FLUORIDE WITH HEX AND HYDROGEN FLUORIDE. R. E. Worthington. Jan. 1957. 12p.

It is shown that uranium hexafluoride reacts with sodium fluoride at temperatures between 80 and 130°C to give Na_3UF_9. This compound decomposes thermally, at temperatures above 130°C, in two ways, which occur simultaneously: to yield sodium fluoride and uranium hexafluoride and to yield trisodium heptafluoruranate, Na_3UF_7, and fluorine. The reaction kinetics of the combination reaction obey a logarithmic law. When sodium fluoride reacts with mixtures of hex and hydrogen fluoride, the reaction product is a mixture of $NaF \cdot HF$ and Na_3UF_9. The quantity of hydrogen fluoride reacting to form $NaF \cdot HF$ depends on its concentration in the original mixture. Once the hex has been taken up to form Na_3UF_9, it cannot be displaced by hydrogen fluoride. The reaction rates of hex and hydrogen fluoride with sodium fluoride are very similar, differing only by a factor of one or two. (auth)

7482 IGR-R/CA-248

United Kingdom Atomic Energy Authority. Industrial Group. Capenhurst Works, Capenhurst, Ches., England.

THE CONDENSATION COEFFICIENT OF BORON TRIFLUORIDE. M. C. Paterson and R. Hulse. Nov. 1957. 15p.

Experiments were performed to study the rate of condensation of boron trifluoride on a copper surface maintained at liquid-nitrogen temperature (−195°C). The condensation coefficient was found to be in the range $(2.85 \pm 23\%) \times 10^{-2}$. Using this value for the condensation coefficient, values for the thermal conductivity of the solid deposit are deduced; a mean value is $(9.3 \pm 2.8\%) \times 10^{-4}$ cal/cm s deg C at −166°C, which is in agreement with that found by other investigators. (auth)

7483 IGR-TM/C-039

United Kingdom Atomic Energy Authority. Industrial Group. Culcheth Labs., Culcheth, Lancs, England.

THE REACTION OF POTASSIUM WITH WET OXYGEN: REPORT OF PROGRESS TO MARCH 31, 1956. P. B. Longton. May 17, 1956. 12p.

The reaction of potassium metal with wet oxygen, containing 0.25 mg/liter H_2O at S.T.P., was studied over the pressure range 10 to 600 mm Hg at temperatures from 30 to 180°C. In all cases, reaction was found to occur at a measurable rate. With solid potassium (30 to 60°C) a linear oxidation law was found to be valid, while with liquid potassium (70 to 100°C) a parabolic relationship was evident. At temperatures above 150°C autoignition spontaneously occurred as a consequence of the heat evolved during the reaction. Ignition, under these circumstances, was both spasmodic and feeble and was not capable of being induced reproducibly. Visible surface films were at all times present after reaction had commenced. (auth)

7484 IGR-TM/W-055

United Kingdom Atomic Energy Authority. Industrial Group. Windscale Works, Sellafield, Cumb., England.

URANIUM PARTITION COEFFICIENTS AT LOW URANIUM CONCENTRATIONS IN NITRIC ACID–20% TBP/OK SYSTEMS. A. Duncan and G. A. Holburt. May 30, 1956. 8p. (IGC-DCPWP/P-66).

Factorial regression analysis of the results show that at the low uranium concentrations the uranium partition coefficient K_u is not affected by change of uranium concentration; K_u, however, changes markedly with change of nitric acid, particularly in the region 0 to 0.5N. A nomogram was constructed of K_u versus nitric acid concentration. To check the nomogram, partition coefficients of uranium at 1.0 and 3N acidity were determined. (auth)

7485 ISC-1096

Ames Lab., Ames, Iowa.

EXCHANGE AND CHEMICAL REACTIONS OF CYCLOPENTADIENYL-COBALT COMPLEXES. Seymour Katz, James Weiher, and A. F. Voigt. Nov. 1958. 119p. Contract [W-7405-eng-82]. $18.30(ph), $6.00(mf) OTS.

The electron exchange between bis(π-cyclopentadienyl)-cobalt(II) and bis(π-cyclopentadienyl)cobalt(III) perchlorate in acetone solutions was studied at 0°C in the virtual absence of air. A large zero time exchange followed by a slow exchange reaction was observed. A study of the effect of $(C_5H_5)_2Co$ concentration on the zero time exchange and the half time of the slow reaction led to the conclusion that the electron exchange was very rapid ($t_{1/2} < 5$ sec). The high zero time exchange is attributed to this reaction; and the slow exchange to the following two equilibria:

$$[(C_5H_5)_2Co^{60}]^+ + [(C_5H_5)_2Co]_2O \overset{k_1}{\rightleftharpoons} [(C_5H_5)_2Co]^+ + [(C_5H_5)_2Co^{60}]\,[(C_5H_5)_2Co]O$$

$$(C_5H_5)_2Co^{60} + [(C_5H_5)_2Co]_2O \overset{k_2}{\rightleftharpoons} (C_5H_5)_2Co + [(C_5H_5)_2Co^{60}]\,[(C_5H_5)_2Co]O.$$

The presence of $[(C_5H_5)_2Co]_2O$ in the reaction solutions is assumed to be due to the oxidation of $(C_5H_5)_2Co$ by oxygen impurities. It appears that $k_1 = k_2$ (0.029 liter/mole sec) and that the over-all kinetics for both reactions is second order, i.e., first order in each of the reactants. A qualitative understanding was obtained of the complex reaction between $(C_5H_5)_2Co$ and oxygen in mesitylene solutions. The uptake of oxygen was studied over a range 0 to 1.5 moles of oxygen per mole of $(C_5H_5)_2Co$. The initial reaction was observed to be very fast, and chemical evidence indicates that the first product formed was $[(C_5H_5)_2Co]OH$. At 0°C this reaction takes place during the uptake of 0 to 0.5 mole of oxygen per mole of $(C_5H_5)_2Co$. The second reaction appears to accompany the decomposition of $[(C_5H_5)_2Co]OH$ which is complete after the uptake ratio (moles O_2/mole $(C_5H_5)_2Co$) is unity. The products of this reaction have not been identified. From the reaction of $(C_5H_5)_2Co$ with carbon tetrachloride a new type of cyclopentadienyl cobalt compound was isolated which had the formula $(C_5H_5)_2(CCl_3)Co$. It was named (π-cyclopentadienyl)(σ-cyclopentadienyl)trichloromethylcobalt(III) since the infrared and chemical data lead to the conclusion that the formation of the compound involves an interesting rearrangement in the bonding, from very stable π to less stable σ. The conversion of this compound in ethanol solutions to $[(C_5H_5)_2Co]^+$ indicates that a reverse rearrangement of σ to π bonding also occurs. The production of $(C_5H_5)_2(CCl_3)Co$ from the reaction of $(C_5H_5)_2Co$ and chloroform demonstrated that the mechanism of its formation involves free radical reactions. (auth)

7486 KLX-10076
Vitro Labs., West Orange, N. J.
ELECTROKINETIC PROCESSES—NUCLEAR ASPECTS SUMMARY REPORT [FOR PERIOD] NOVEMBER 1, 1953—NOVEMBER 30, 1956. A. C. Werner and H. Katz. July 12, 1957. Decl. May 7, 1958. 13p. Contract AT(30-1)-850. $3.30(ph), $2.40(mf) OTS.

Progress in electrophoretic deposition is summarized, and references are made to previous reports in which the information is reported in detail. (W.L.H.)

7487 LA-2270
Los Alamos Scientific Lab., N. Mex.
THE GRAVIMETRIC DETERMINATION OF TUNGSTEN IN URANIUM-TUNGSTEN ALLOYS. Robert L. Carpenter, Ross D. Gardner, William H. Ashley, and Arthur L. Henicksman. Sept. 1958. 11p. Contract W-7405-Eng-36. $0.50(OTS).

Tungsten in uranium—tungsten alloys is determined by precipitating the tungsten from a cold sulfuric acid solution using α-benzoinoxime and cinchonine as the precipitating agents. The precipitate is ignited at 800°C and weighed as WO_3. Results of 94 determinations on known samples containing 20 to 40 milligrams of tungsten in the presence of 1 to 8 grams of uranium showed an average recovery of 100.1% with a standard deviation of 0.7%. (auth)

7488 NP-7222
General Electric Co. General Engineering Lab., Schenectady, N. Y.
EVALUATION OF EXPERIMENTAL POLYMERS FOR DIELECTRIC APPLICATIONS. FURTHER EVALUATION OF DIFFERENTIAL THERMAL ANALYSIS AND THERMOGRAVIMETRIC ANALYSIS AS MEANS OF DETERMINATING THERMAL STABILITY OF ORGANIC POLYMERS. C. D. Doyle and J. A. Hill. THERMOGRAVIMETRIC INVESTIGATIONS. A. E. Newkirk and H. W. Middleton. Quarterly Progress Report No. 3 [for] October 5, 1958 to January 5, 1959. Jan. 15, 1959. 64p. Project No. 8-(8-7371). Contract AF33(616)-5576.

The 21 polymers, originally obtained from WADC, and five additional conventional polymers were subjected to differential thermal analysis in ambient air. Five of the 21 polymers were also subjected to thermogravimetric analysis in ambient air. (auth)

7489 NP-7231
Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.
SPECTROPHOTOMETRIC DETERMINATION OF CONTAMINATIONS IN NUCLEARLY PURE URANYL NITRATE. Report No. 45/VIII. T. Nowicka-Jankowska, A. Gołkowska, I. Pietrzak, and W. Żmijewska. Nov. 1958. 42p.

Methods of determining trace amounts of nickel, aluminum, silicon, molybdenum, chromium, and iron in uranyl nitrate are presented. Nickel is determined with dimethylglyoxine, aluminum with hematoxylin, and silicon with molybdenum blue. Molybdenum may be determined by the thiocyanate method, or with dithiol, while chromium is determined with diphenylcarbazide, and iron with α,α'-dipyridyl. (J.R.D.)

7490 NP-7244
Ohio State Univ. Research Foundation, Columbus.
THE REACTION OF $B_2O_3(l)$ AND CARBON AT ELEVATED TEMPERATURES. Technical Report No. 1. P. M. Rentzepis and David White. Jan. 1959. 12p. Contract Nonr-495(12).

The reaction of $B_2O_3(l)$ + C in the temperature range 1350 to 1650°K was investigated in an effort to establish at least a lower limit for the heat of formation of $B_2O_2(g)$. Combining the existing data in the literature, which probably represent an upper limit for the heat of formation of B_2O_2, with the value reported obtained, ΔH^0_f ($B_2O_2(g)$) is considered reliably in the range -108 ± 3 kcal per mole. (auth)

7491 NP-7265
Massachusetts Inst. of Tech., Cambridge.
LITHIUM ORES AND THEIR PROCESSING IN THE USSR. An Organized Review of the Published Soviet Literature, 1929—1958. A. M. Gaudin and L. T. Romankiw. Jan. 31, 1959. 44p.

The study was made to evaluate the character and quality of the progress made by Soviet scientists and engineers in the processing of lithium ores for the production of lithium salts and metallic lithium. 114 references. (auth)

7492 NP-7297
Midwest Research Inst., Kansas City, Mo.
RESEARCH ON HIGH TEMPERATURE METALLO-ORGANIC AND INORGANIC BASE FLUIDS. Quarterly Progress Report No. 3 [for] October 16, 1958—January 31, 1959. L. W. Breed. 39p. M.R.I. Project No. 2194-C. Contract AF33(616)-5718.

Data for 22,240 inorganic and metallo-organic compounds have been collected, the structures coded, and all information entered on IBM punch-cards. An analysis of the data to find correlations among liquid range, thermal stability, melting point, boiling point, formula weight, and structural features of the compounds is now being carried out. In the report a discussion of the limitations and possibilities of such a data correlation program is included. (auth)

7493 SO-3600(Rev.)
Metals and Controls Corp., Attleboro, Mass.
SPECTROGRAPHIC ASSAY OF U^{235} WITH THE ECHELLE SPECTROGRAPH. R. J. Murphy. Nov. 1, 1954. Decl. Mar. 12, 1957. 10p. $1.80(ph), $1.80 (mf) OTS.

The application of the Bausch and Lomb echelle spectrograph to the problem of assaying the U^{235} content of U metal is described. An outline of the method is given in addition to a discussion of the features of the echelle spectrograph. (auth)

7494 TID-7531(Pt.2)(Del.)
Division of Nuclear Materials Management, AEC and Chicago Operations Office, AEC.
MODERN APPROACHES TO ISOTOPIC ANALYSIS OF URANIUM. A Conference Held at Chicago, February 5-7, 1957. 69p. $10.80(ph OTS); $3.90(mf OTS).

Six papers are presented on methods of isotopic analysis of uranium. Separate abstracts have been prepared for each paper. (T.R.H.)

7495 TID-7531(Pt. 2)(Del.)(p.7-16)
Oak Ridge Gaseous Diffusion Plant, Tenn.
ESTIMATION OF ISOTOPIC RATIOS IN URANIUM HEXAFLUORIDE USING DUAL IONIZATION CHAMBERS. J. H. Lykins, E. C. Denny, and W. G. Schwab. p.7-16 [of] MODERN APPROACHES TO ISOTOPIC ANALYSIS OF URANIUM. A Conference Held at Chicago, February 5-7, 1957. 10p.

A dual ionization chamber method was investigated for possible use in estimating small differences in uranium-235 concentrations in uranium hexafluoride. Two ionization chambers are connected in ion polarity

opposition, and the differential ion current is collected on a capacitor. Instrumentation automatically converts the information to digital form and records the time required to collect a fixed charge. Also studied was an alternative method of measuring the ratios of times required for the voltage to change by a fixed interval. Current work consists of determining optimum pressures and voltages for chamber operation, the effect of memory, and the effect of impurities in the uranium hexafluoride. (auth)

7496 TID-7531(Pt. 2)(Del.)(p.17-24)
ISOTOPIC ANALYSIS OF URANIUM BY THE EMISSION SPECTROGRAPH. R. E. Kupel and W. Tichy. p.17-24 [of] MODERN APPROACHES TO ISOTOPIC ANALYSIS OF URANIUM. A Conference Held at Chicago, February 5-7, 1957. 8p.

Isotopic analysis of uranium in the 90% enrichment range can be accomplished easily and quickly on the emission spectrograph. Two graphite electrodes are loaded with an equal mixture of graphite and uranium and excited in an a-c arc. The resulting spectra are monitored on a densitometer to obtain the relative intensities of the 4244.37A line and the 4261.51A line. The ratio of the relative intensities of these two lines is then applied to a concentration curve and the % U-238 is obtained from this curve. A known amount of material is weighed and dissolved in nitric acid. A measured volume of solution is evaporated on a stainless steel disk and the alpha activity is obtained using a proportional counter. The % U-234 is calculated from the alpha activity, the % U-238 is obtained as described above, and the % U-235 is then obtained by difference, assuming only the three isotopes present. The accuracy of this method compares favorably with the Mass Spectrometer method. The precision of the method at the 95% confidence level is ± 0.30%. (auth)

7497 TID-7531(Pt. 2)(Del.)(p.25-31)
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
ISOTOPIC ANALYSIS OF URANIUM BY EMISSION SPECTROSCOPY. G. V. Wheeler. p.25-31 [of] MODERN APPROACHES TO ISOTOPIC ANALYSIS OF URANIUM. A Conference Held at Chicago, February 5-7, 1957. 7p.

Isotopic analysis of uranium by emission spectroscopy has been investigated at the Idaho Chemical Processing Plant in three phases; a literature search, an investigation with equipment available at the I.C.P.P., and an investigation with high resolution direct reading equipment available commercially. These investigations are discussed and the conclusion drawn that though more work remains to be done, uranium can be assayed for U^{230}, U^{235}, U^{236}, and U^{238} by emission spectroscopic means with precision approaching that of mass spectrometers at much lower cost. (auth)

7498 TID-7531(Pt. 2)(Del.)(p.32-46)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
A GAMMA COUNTING METHOD FOR THE DETERMINATION OF U-235 IN ENRICHED URANIUM. U. L. Upson and D. G. Miller. p.32-46 [of] MODERN APPROACHES TO ISOTOPIC ANALYSIS OF URANIUM. A Conference Held at Chicago, February 5-7, 1957. 15p.

The uranium-235 can be detected and measured in the presence of other uranium isotopes and their daughters by selectively counting its 184 kev gamma. The determination of the U-235 content of highly-enriched uranium in aluminum alloys is described. In this case it is possible to do the counting on small volumes of dissolved samples of the alloy without separation of aluminum or of the uranium daughters. Precision of ±1.2 percent, at the 95 percent confidence level, is possible by the technique described. The effects of daughter growth and of separation of the uranium from the aluminum are discussed, as well as other methods for improving precision. (auth)

7499 TID-7531(Pt. 2)(Del.)(p.47-52)
Oak Ridge National Lab., Tenn.
URANIUM-235 ABUNDANCE BY GAMMA SPECTROMETRY. S. A. Reynolds and J. S. Eldridge. p.47-52 [of] MODERN APPROACHES TO ISOTOPIC ANALYSIS OF URANIUM. A Conference Held at Chicago, February 5-7, 1957. 6p.

Techniques are described for determining uranium-235 abundance by measurement of the intensity of 0.18-Mev gamma radiation. One method involves measurement of the ratio of the intensity of 0.18-Mev radiation to that of ~0.1-Mev radiation. The preferred technique consists of chemical separation of uranium, followed by direct counting of 0.18-Mev photons. Application has been made in analysis of uranium samples of abundances in the range of 0.05% to 93%. Accuracy appears to be better than 3% if the abundance is between 0.7% and 100%. Findings in the self-absorption of 0.18-Mev radiation in uranium oxide are presented. (auth)

7500 TID-7531(Pt. 2)(Del.)(p.53-69)
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
TESTING OF NUCLEAR FUELS BY THE DANGER COEFFICIENT METHOD. M. E. Remley and B. A. Engholm. p.53-69 [of] MODERN APPROACHES TO ISOTOPIC ANALYSIS OF URANIUM. A Conference Held at Chicago, February 5-7, 1957. 17p.

Reactors operating at essentially zero power can be used as sensitive non-destructive test instruments for quality control and isotopic assay determinations of nuclear fuels. Use of a zero-power water boiler for this type of testing has been investigated in a series of experiments performed with the Water Boiler Neutron Source at Atomics International. Uranium cylinders, 3.875 inches in length by 0.500, 0.600, and 0.750 inch in diameter, with enrichments in U-235 of 0.491, 0.711, 0.902, 1.399, and 2.778 weight per cent have been compared by the danger coefficient method. This method with the water boiler will detect U-235 enrichment differences of 9×10^{-4} weight per cent for samples enriched to one per cent in U-235 and differences of 2.8×10^{-3} weight per cent in samples of three per cent enrichment. A suggested procedure for the application of the method to the routine testing of fuel material is outlined. (auth)

7501 UCRL-5346
California. Univ., Livermore. Radiation Lab.
DETERMINATION OF LOW CHLORINE CONCENTRATION IN PLASTICS. David M. Colman. Sept. 5, 1958. 5p. Contract W-7405-eng-48. $0.50(OTS).

A rapid method is presented for the determination of low chlorine concentrations in plastics. The method is based upon combustion in a Parr oxygen bomb, an ion exchange step to remove interfering cations, and a mercuric perchlorate titration using diphenylcarbazide as the indicator. The precision is of the order of 0.005%. (auth)

7502 AEC-tr-3539
AN APPARATUS FOR THE JOINT DETERMINATION OF VISCOSITY, DENSITY AND THE FUSION-SOLIDIFICATION TEMPERATURE. N. S. Bubyreva, B. I. Markin, B. P. Bindas, Yu. (Iu.) A. Silkin, and K. V. Chmutov. Translated for Los Alamos Scientific Lab. from Zhur. Fiz. Khim. 31, 2580-3(1957). 5p. $1.80(ph), $1.80(mf) JCL or LC.

A compound instrument for the joint determination by remote control of certain physico-chemical constants of liquids such as the density, viscosity, and the fusion solidification temperature is described. Diagrams are included as well as operating procedures. The instrument was used in a study of electrolyte solutions, demonstrating good measurement reproducibility. (J.R.D.)

7503 AEC-tr-3551
PREPARATION AND PROPERTIES OF MAGNESIUM HYDRIDE. (Preparation et Proprietes de l'hydrure de Magnesium.) W. Freundlich and B. Claudel. Translated for Mallinckrodt Chemical Works from Bull. soc. chim. France, 967-70(1956). 11p. $3.30 (ph), $2.40(mf) JCL or LC.

Preparation of magnesium hydride by pyrolysis of organomagnesium compounds was investigated. In addition, the chemical and physical properties of this hydride were investigated to ascertain whether the difference in its properties from those of the hydride obtained through direct synthesis is attributable to a difference in structure or simply a difference in purity and size of the crystallites. The experimental technique is given as well as a scheme for the reaction. (J.R.D.)

7504 AEC-tr-3566
VIBRATION SPECTRA OF MELTS, GLASSES AND CRYSTALS OF SODIUM DI-, TRI-, AND TETRAPHOSPHATES. W. Bues and H. W. Gehrke. Translated by G. M. Wolten (Atomics International) from Z. anorg. u. allgem. Chem. 288, 291-306(1956). 11p. (Figures omitted). $3.30(ph), $2.40(mf) JCL or LC.

Vibration spectra of melts and glasses in the system $NaPO_3-Na_4P_2O_7$ are described and assigned. At stoichiometric compositions of the melt, tri- and tetraphosphate ions exist as definite poly-anions at temperatures slightly above the liquidus. If conditions are rigidly controlled, glasses may be obtained from these melts, consisting of definite poly-anions. (auth)

7505 CEA-tr-A266
LES MATIERES PLASTIQUES ANTICORROSIVES ET LEURS APPLICATIONS DANS LA CONSTRUCTION D'APPAREILS UTILISES EN CHIMIE. (Anticorrosive Plastic Materials and Their Application in the Construction of Chemical Apparatus.) Otto Dammer. Translated into French from Chem.-Ingr.-Tech. 26, 562-5(1954). 17p.

A brief survey is made of the properties of anticorrosive plastics and their uses in the construction of chemical apparatus. Plastics can also be used for piping corrosive substances and as protective coatings on free surfaces and structures. (J.S.R.)

7506 CEA-tr-R-243
EFFET ISOTOPIQUE DANS L'ÉQUILIBRE LIQUIDE-VAPEUR DE SYSTÈMES BINAIRES RENFERMANT DES COMPOSÉS DEUTÉRÉS. (Isotopic Effect in the Liquid-Vapor Equilibrium of Binary Systems Containing Deuterated Compounds.) I. B. Rabinovich (Rabinovitch), P. N. Nikolaev, Z. E. Gochaliev (Gotchaliev), and N. N. Tretyakova (Tretiakova). Translated into French from Doklady Akad. Nauk S.S.S.R. 110, 241-4(1956). 10p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 11, as abstract No. 1790. (J.S.R.)

7507 CEA-tr-R-550
PRÉPARATION DE BORE AMORPHE DE GRANDE PURETÉ. IV. ESTIMATION DE LA QUALITÉ DU BORE AMORPHE. (Preparation of Amorphous Boron of High Purity. IV. Estimation of the Quality of Amorphous Boron.) V. I. Mikheeva, F. I. Shamrai (Chamrai), and E. Ya. Krylova (E. Ia. Krilova). Translated into French from Zhur. Neorg. Khim. 2, 1248-53(1957). 16p.

A study was made of the determination of boron in preparations of amorphous boron. It is shown that the total boron can be determined without the separation of boric acid by titration with an alkali solution in the presence of mannite. The amount of active boron and boron in the form of lower oxides can be estimated by the combined use of titration with ceric sulfate and the displacement of gold from its compounds by boron. (J.S.R.)

7508 CEA-tr-R-568
CINÉTIQUE DE LA RÉACTION DU LITHIUM AVEC DES VAPEURS DE CHLORURE D'ETHYLE. (Kinetics of the Reaction of Lithium with Vapors of Ethyl Chloride.) V. A. Chouchounov and A. P. Aurov (Aourov). Translated into French from Zhur. Fiz. Khim. 23, 1197-1202(1949). 13p.

The kinetics of the reaction of lithium with ethyl chloride vapor was studied. The results showed that the reaction is a topochemical reaction. The activation energy, calculated according to the variation of the induction period as a function of the temperature, is equal to 19,800 cal/mole. The value of n in the kinetic equation of topochemical reactions $-\Delta p = at^n$ (where Δp is the drop in vapor pressure, t is the time of the reaction, and a and n are constants) decreases with the increase of temperature. (tr-auth)

7509 CEA-tr-R-576
ECHANGE ISOTOPIQUE DU SOUFRE ENTRE L'HYDROGÈNE SULFURÉ ET LE 2-MERCAPTOBENZOTHIAZOLE. (Isotopic Exchange of Sulfur Between Hydrogen Sulfide and 2-Mercaptobenzothiazole.) A. F. Rekacheva, G. A. Blokh, and G. P. Mikloukhine. Translated into French from Zhur. Obschei Khim. 25, 1631-6(1955). 10p.

A method for the study of exchange reactions between the sulfur of hydrogen sulfide and that in organic compounds was proposed. The kinetics of the exchange reactions in the 2-mercaptobenzothiazole–hydrogen sulfide system was studied. It was shown that this reaction is of a fractional order. The possible mechanisms for the exchange reactions with hydrogen sulfide were studied. (tr-auth)

7510 NP-tr-220
ON THE QUESTION OF THE POTENTIAL DIFFERENCE AT THE GAS–WATER BOUNDARY. A. N. Frumkin, Z. A. Iofa, and M. A. Gerovich. Translated for Amherst Coll., Mass. from Zhur. Fiz. Khim. 30, 1455-68(1956). 28p.

Data are presented which emphasize the dependence upon concentration (in dilute solutions) of the potential difference on the air–water boundary of electrolytes. In addition, data on the temperature coefficient of the

potential difference at the ends of a cell containing the phase boundaries are given for water–air and alcohol–air. The different methods of determining the potential difference are considered, and it is shown that there probably is a small positive value for the potential of about 0.1 to 0.2 volts. (J.R.D.)

7511

DETERMINATION OF THORIUM IN URINE. George A. Welford, Doris C. Sutton, Robert S. Morse, and Seymour Tarras (U. S. Atomic Energy Commission, New York). Am. Ind. Hyg. Assoc. J. 19, 464-8(1958) Dec.

Based on the biochemical similarity of Th and Pu, the indicated minimum sensitivity required to study the excretion rate and body burden of Th is 0.2 μg/l of urine. Several spectrophotometric methods are capable of detecting this quantity of Th. Procedures for using these methods are detailed, and results are given from analyses using Chrome Azuro S, Thorin, and Morin. (D.E.B.)

7512

SOME OBSERVATIONS ON RUTHERFORDINE. Joan R. Clark and C. L. Christ (U. S. Geological Survey, Washington). Am. Mineralogist 41, 844-50(1956).

The optical properties of rutherfordine, UO_2CO_3, have been redetermined on sizeable crystals and the relations among the indices of refraction, the morphology, and the crystal structure have been examined. Rutherfordine is orthorhombic, biaxial positive, with α = 1.715, β = 1.730, γ = 1.795, 2V = 53° (calc.); X = b, Y = c, (elongation), Z = a. The crystal structure of UO_2CO_3 consists of layers of carbonate groups parallel to (010) with linear $(O\text{-}U\text{-}O)^{+2}$ ions normal to the layers. The indices β and γ correspond to vibration directions parallel to layers; the unexpectedly large difference in value between β and γ is ascribed to the optical anisotropy of the uranium-oxygen bonding in the layer. Indexed x-ray powder data are given. (auth)

7513

POTASSIUM BROMIDE METHOD OF INFRARED SAMPLING. Robert G. Milkey (U. S. Geological Survey, Washington). Anal. Chem. 30, 1931-3(1958) Dec.

In the preparation of potassium bromide pressed windows for use in the infrared analysis of solids, severe grinding of the potassium bromide powder may produce strong absorption bands that could interfere seriously with the spectra of the sample. These absorption bands appear to be due to some crystal alteration of the potassium bromide as a result of the grinding process. They were less apt to occur when the coarser powder, which had received a relatively gentle grinding, was used. Window blanks prepared from the coarser powders showed smaller adsorbed water peaks and generally higher over-all transmittance readings than windows pressed from the very fine powders. (auth)

7514

SHORT SURVEY OF THE SEPARATION METHODS FOR ZIRCONIUM AND HAFNIUM. Nikola Getoff (Osterreichischen Stickstoffwerke A.G., Linz, Austria). Atompraxis 4, 448-50(1958). (In German)

After a discussion of the essential ways to use zirconium as a construction material for nuclear reactors, a critical review is given of the most common chemical methods for separation of zirconium and hafnium. (auth)

7515

MEASUREMENTS OF LIQUIDS OF LOW SPECIFIC ACTIVITY WITH A SCINTILLATION COUNTER. K. Jordan. Atomwirtschaft 3, 496-501(1958) Dec. (In German)

Measurement of gamma activities of less than a few 10^{-8} microcuries/cm^3 in liquids can be made with a scintillation counter with a NaI(Tl) crystal of suitable size with appropriate protection. The lower limit of measurement is determined by the time of counting and experimental error. A selective measurement of a given gamma energy is possible using an amplitude discriminator. (auth)

7516

THE DETERMINATION OF ATOMIC RATIOS IN THE URANIUM–OXYGEN SYSTEM BY A THERMOGRAVIMETRIC METHOD. L. G. Stonhill (Eldorado Mining and Refining, Ltd., Ottawa). Can. J. Chem. 37, 454-9 (1959) Feb.

A description is given of a thermogravimetric oxidation–reduction method for determining U–O ratios, especially suited to oxygen-sensitive materials of undetermined purity, and equally applicable to pure stoichiometric and non-stoichiometric oxides and their mixtures with each other and with uranium metal. Provided that no uncombined base metals other than uranium, and no oxidizable or reducible matter other than its oxides, are present, it is not essential to know the detailed composition of the sample, since the assay is based on interconversion of the stoichiometric oxides UO_2 and U_3O_8 within that sample. Incidental advantages of this method are: the avoidance of manipulation of the sample during the determination, precise reaction control, and immediate recording of the completion or otherwise of the required reaction. (auth)

7517

COMPLEXOMETRICAL TITRATION. XXXIV. "CROMEAZUROL S" AS INDICATOR FOR THE DETERMINATION OF THORIUM, NICKEL, CERIUM AND LANTHANUM. M. Malat and M. Tenorova. Chem. listy 51, No. 11, 2135-7(1957). (Translated from Referat. Zhur. Khim. No. 17, 1958, Abstract No. 57137.)

The possibility of using Chromeazurol S for the titration of Th, Ni, Ce, La, and other rare earth elements was investigated. The interfering ions were determined, and the means of eliminating them were studied. (J.S.R.)

7518

POLAROGRAPHIC DEPOLARIZING ACTION OF THORIUM IONS AND SOME OTHER HYDROLYZABLE CATIONS. Jiri Masek. Chem. listy 52, No. 1, 7-15 (1958). (Translated from Referat. Zhur. Khim. No. 22, 1958, Abstract No. 73419.)

Three irreversible waves are observed in non-buffer solutions of KCl in the presence of Th^{4+}. The 3rd wave disappears after addition of alcohol. Methyl blue causes a shift of the 1st wave to the more positive E-s. The limiting current of the 1st and 2nd waves is determined by the rate of the chemical reaction. All 3 waves disappear after the addition of alkalies; the 1st wave increases and the 3rd decreases after acid addition. No waves are observed in buffer solutions. It is proved that all 3 waves correspond to the reduction of H^+ ions from the complexes of Th^{4+} with H_2O but not to the Th^{4+} reduction. The polarographic behavior of Al, Zr, and Be ions in aqueous and alcohol media is explained in the same way.

7519

DETERMINATION OF THE ISOTOPIC EQUILIBRIUM CONSTANT OF WATER-SELENIUM HYDRIDE. Daniele

Marx. Compt. rend. 247, 2340-2(1958) Dec. 22. (In French)

The isotopic equilibrium of the reaction $H_2Se + HDO_{liq} \rightleftharpoons HDSe + H_2O_{liq}$ was studied. The equilibrium constants K and k for the gaseous and liquid phases, respectively, were determined as a function of temperature between 0 and 100°C. The results are tabulated. (J.S.R.)

7520

MAGNETIC STUDY OF THE CERIUM–HYDROGEN SYSTEM. EFFECT OF IRON IMPURITIES. ATTEMPT AT INTERPRETATION. Halim J. Albany. Compt. rend. 247, 2343-5(1958) Dec. 22. (In French)

In a series of experiments the magnetic properties of the cerium–hydrogen system were studied. It was found that the presence of iron increases the paramagnetic susceptibility of the system. In iron-free systems, the susceptibility in the interval from Ce to $CeH_{1.9}$ remains the same as that of metallic cerium. The possibility of the diffusion of iron to nonhydrated portions of the sample is discussed. The suggestion that the hydrogen and cerium form an ionic bond is supported by an analysis of the magnetic properties of the system. (J.S.R.)

7521

INTERPRETATION OF THE MAGNETIZATION LAW OF THE ION Yb^{3+} IN THE GALLATE TYPE GARNET. Yves Ayant and Jean Thomas. Compt. rend. 248, 387-9 (1959) Jan. 19. (In French)

The magnetization at low temperature of ytterbium in an electric field of cubic symmetry was calculated by elementary methods once the operator $H^4_{7/2} = J^4_x + J^4_y + J^4_z - 3/(2J + 1)\mathrm{Tr}\, J^4_z$ is known. The agreement with experimental values is good. (tr-auth)

7522

THE EFFECT OF SALTS ON DEUTERIUM EXCHANGE IN LIQUID AMMONIA. A. I. Shatenstein, Yu. P. Vyrskii, and E. A. Rabinovich (Karpov Research Inst. of Physics and Chemistry). Doklady Akad. Nauk S.S.S.R. 124, 146-9(1959) Jan. 1. (In Russian)

In the analysis it was assumed that the salt effect in deuterium exchange and solvolytic reactions in liquid ammonia are analogous. The rate constants (sec^{-1}) are calculated using the first-order equation. Measurements of deuterium exchange kinetics confirmed the initially suggested approximation. (R.V.J.)

7523

THE CHEMICAL ANALYSIS IN THE QUALITY CONTROL OF NUCLEAR GRAPHITE. P. M. Strocchi, S. Noè, and P. Rebora. Energia nucleare (Milan) 5, 815-23(1958) Dec. (In Italian)

The principles to be followed for the quality control of nuclear graphite by means of chemical analysis are described, and the range and limits of the method, depending on the precision attainable by the analytical procedures, are established. A new quantity is proposed in order to simplify the calculations of the over-all absorption cross section of the material, provided that its chemical composition is known. (auth)

7524

CONCENTRATION AND DETERMINATION OF BORON FROM DILUTED SOLUTIONS CONTAINING STRONG AND WEAK ELECTROLYTES. E. Cerrai, and C. Testa (CISE–Milan). Energia nucleare (Milan) 5, 824-30 (1958) Dec.

A method is reported for the concentration and purification of boron from diluted aqueous solutions containing strong and/or weak electrolytes. This method, based on ion exchange resins, is applied to analytical determination by means of colorimetry. (auth)

7525

SOME EXPERIMENTS ON THE Sr^{2+} UPTAKE BY $MnO(OH)_2$. T. Gerevini and E. Lazzarini (Istituto di Fisica Sperimentale del Politecnico, Milan). Energia nucleare (Milan) 5, 831-3(1958) Dec.

Sr^{2+} coprecipitation on $MnO(OH)_2$ was investigated. Removal coefficients were determined as a function of contact time, pH, and strontium concentration. Tracer techniques were employed. (auth)

7526

KINETIC ISOTOPE EFFECT AND ISOMERIC RATIOS IN THE COUPLING OF DEUTERATED 1-NAPHTHOL-3-SULFONIC ACID. R. Ernst, O. A. Stamm, and Hch. Zollinger (Univ. of Basel). Helv. Chim. Acta 41, 2274-8(1958). (In German)

Diazo couplings of 4-chlorodiazobenzene with deuterated 1-naphthol-3-sulfonic acid show an isotope effect ($k_H/k_D = 3.1$) which is smaller than the isotope effect of the analogous reaction with 2-naphthol-6,8-disulfonic acid. These differences are explained as a function of k_{-1}, i.e., the rate of the reverse reaction of the first step. This constant is influenced by the different steric conditions in the intermediate stages of the reactions. In the coupling of deuterated 1-naphthol-3-sulfonic acid, an "orientation isotope effect" is found. The o/p ratio has a larger value because the para coupling is more strongly base catalyzed than the ortho reaction. Therefore, the kinetic isotope effect of the para coupling is larger. (auth)

7527

THE SEPARATION TUBE. XXII. EFFECT OF THE MASS DISTRIBUTION IN THE THERMAL DIFFUSION BETWEEN Ar^{40} AND HCl^{35}, HCl^{37}, DCl^{35}, AND DCl^{37}. Klaus Clusius and Peter Flubacher (Univ. of Zurich). Helv. Chim. Acta 41, 2323-31(1958). (In German)

The thermal diffusion α of Ar^{40} in HCl^{35}, HCl^{37}, DCl^{35}, and DCl^{37} was measured at a temperature of 107°C. The α value increases in the sequence HCl^{35}, HCl^{37}, DCl^{35}, and DCl^{37}, instead of increasing with molecular weight. The simple mixture law is valid in the transition from H to D compounds, as it is in the transition from Cl^{35} to Cl^{37} compounds, but with a different factor. Apparently the effect is connected with the effect of the rotational quanta. The system of curves for the α value has the typical appearance of curves for the simultaneous effect of mass and diameter. (J.S.R.)

7528

KINETICS OF THE URANIUM–STEAM REACTION. B. E. Hopkinson (Atomic Energy Research Establishment, Harwell, Eng.). J. Electrochem. Soc. 106, 102-6(1959) Feb.

Reaction rates of unalloyed uranium with superheated steam at 160 to 1400°C and 1 atm. pressure have been determined by a thermogravimetric method. Up to 880°C the reaction follows a linear rate law with maximum rates at approximately 300 and 750°C. Above 880°C a parabolic rate law applies for the first 60 to 120 min, after which corrosion is linear; the oxide formed in the initial period gives protection to the underlying metal, and the subsequent linear rate is as low as that at about 200°C. X-ray diffraction of the reaction product indicated that uranium dioxide was formed over almost the whole temperature range. (auth)

7529

DETERMINATION OF TITANIUM, ZIRCONIUM, NIOBIUM, AND TANTALUM IN STEELS: SEPARATIONS BY ANION-EXCHANGE. John L. Hague and Lawrence A. Machlan. J. Research Natl. Bur. Standards 62, 11-19(1959) Jan.

A procedure is described for the determination of titanium, zirconium, niobium, and tantalum in steel. These elements are concentrated by selective precipitation with cupferron from a hydrochloric acid solution of the sample, and then ignited to the oxides. The oxides are fused, and dissolved in a hydrochloric-hydrofluoric acid mixture. Three separate eluates, containing titanium and zirconium, niobium, and tantalum, result from elution with mixtures containing ammonium chloride, hydrochloric acid, and hydrofluoric acid from a column of Dowex-1 anion-exchange resin. Boric acid is added to the eluates to complex the hydrofluoric acid, and the elements are precipitated with cupferron. Titanium is determined by the hydrogen-peroxide method, and zirconium by the phosphate-gravimetric method. Niobium and tantalum are determined by the hydroquinone- and pyrogallol-photometric methods, or by weighing the oxides. (auth)

7530

A COMPLEXOMETRIC MICRODETERMINATION OF THORIUM. Kérēsh Prshibil. Magyar Kém. Folyóirat 64, No. 2, 55-7(1958). (Translated from Referat. Zhur. Khim. No. 21, 1958, Abstract No. 70540.)

The known complexometric methods for the determination of Th were subjected to a critical examination. A technique for the microdetermination (tenth parts of mg) of Th was worked out. A complexometric indicator, Xylene Orange, was used which at a pH from 2 to 7 forms complexes with heavy metals, which are destroyed by Complexone III. To determine Th, the indicator is added to the solution being analyzed (the pH of which has first been adjusted to 1.5 to 3.5 with HNO_3 or NH_4OH) and the solution is then titrated with 0.01 or 0.001 M Complexone III until the color changes from reddish-violet to yellow. In the determination of Th the ions SO_4^{2-}, CH_3COO^-, halides (except F^-), cations of alkaline earth metals, and NH_4^+ do not interfere. The interference caused by Zn^{2+}, Al^{3+}, La^{3+}, Mn^{2+}, Pb^{2+}, Cu^{2+}, and UO_2^{2+} might be easily eliminated by masking, whereas the interfering effect of Fe^{3+}, Co^{2+}, Ni^{2+}, and Cd^{2+} cannot be corrected by simple methods.

7531

PRODUCTION OF IMPERMEABLE GRAPHITE. W. Watt, R. L. Bickerdike, A. R. G. Brown, W. Johnson, and G. Hughes (Royal Aircraft Establishment, Farnborough, Eng.). Nuclear Power 4, 86-8(1959) Feb.

Two processes for the production of graphite with very low permeability to gases are presented. The processes are furfuryl alcohol impregnation and gas impregnation. (W.L.H.)

7532

DETERMINATION OF BORON IN GASEOUS CO_2. Nuclear Power 4, 88(1959) Feb.

The boron is determined absorptiometrically. The limit of detection is judged to be not greater than 0.05 ppm but it depends on the purity of the reagents. (W.L.H.)

7533

POLONIUM. A. Dorabialska. Nukleonika 3, 369-81 (1958). (In Polish)

The chemical properties of polonium are analyzed, and the microcalorimetric method of measuring heat emission and half life of polonium is described. (R.V.J.)

7534

ANTIFERROMAGNETIC PROPERTIES OF THE IRON GROUP TRIFLUORIDES. E. O. Wollan, H. R. Child, W. C. Koehler, and M. K. Wilkinson (Oak Ridge National Lab., Tenn.). Phys. Rev. 112, 1132-6(1958) Nov. 15.

A neutron diffraction study was made of the trifluorides of 3d transition group elements. The arrangement of the magnetic ions and the anions in these trifluorides is similar to that in the compounds $LaMO_3$ for which the antiferromagnetic properties have been studied earlier. No antiferromagnetic transition was observed in VF_3. In the compounds CrF_3, FeF_3, and CoF_3 the magnetic ions are observed to couple antiferromagnetically via the intervening anion to each of their six nearest neighbors. This is the same structure as that found in the compounds $LaCrO_3$ and $LaFeO_3$. In the trifluorides the distortions from cubic symmetry have made it possible to determine the orientation of the spin moments relative to the crystallographic axes and in one case (CrF_3) the antiferromagnetic domain properties have been studied with magnetic fields applied to the sample. In MnF_3 an antiferromagnetic layer structure is found of the type previously observed for $LaMnO_3$. The indirect magnetic coupling in these compounds is correlated with the orbitals which result from the splitting of the d levels by the crystalline field. (auth)

7535

SPECTRAL QUANTITATIVE DETERMINATION OF HAFNIUM IN ZIRCONIUM DIOXIDE. G. I. Kibisov (State Inst. of Applied Chemistry, Leningrad). Zhur. Anal. Khim. 13, 653-6(1958) Nov.-Dec. (In Russian)

Methods were developed for the quantitative spectrographic determination of 0.005 to 3% of hafnium in zirconium dioxide. Samples are burned as thin powder layers on carbon electrodes. The accuracy of the determinations is satisfactory for the control of the separation of hafnium from zirconium. (tr-auth)

7536

SEPARATION OF TITANIUM FROM ACCOMPANYING ELEMENTS BY ION-EXCHANGE CHROMATOGRAPHY. 3. SEPARATION OF TITANIUM AND ZIRCONIUM. T. A. Belyavskaya, I. P. Alimarin, and I. F. Kolosova (Lomonosov Moscow State Univ.). Zhur. Anal. Khim. 13, 668-70(1958) Nov.-Dec. (In Russian)

Distribution coefficients of tetravalent titanium and zirconium between ion-exchange resins and hydrochloric acid solutions of various concentrations were determined. It was found that there is no sorption of the mentioned elements from 0.1 to 6 N hydrochloric acid solutions with anion exchange resins. A method was developed for the quantitative chromatographic separation of titanium and zirconium over the range of ratios Ti:Zr from 1000:1 up to 1:10,000 by means of a hydrochloric acid solution on the cation exchange resin. (tr-auth)

7537

DETERMINATION OF SMALL AMOUNTS OF ZIRCONIUM AND HAFNIUM IN SILICATE ROCKS. A. M. Tuzova and A. A. Nemodruk (Vernadsky Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR, Moscow). Zhur. Anal. Khim. 13, 674-6(1958) Nov.-Dec. (In Russian)

A method was developed for concentrating zirconium and hafnium from silicate rocks containing 0.5 to 1×10^{-4}% of the sum of both elements. The method includes the precipitation of the elements with phenylarsonic acid followed by the re-precipitation by means of 4-dimethylaminoazobenzene-4'-arsonic acid. The yield of each of the elements is 94 to 100%. Due to the high degree of concentration, it is possible to determine each of the elements by the x-ray-spectral method with rather high accuracy. (tr-auth)

7538

ANALYTICAL CHEMISTRY OF HAFNIUM. L. N. Komissarova and V. E. Plyushchev (Lomonosov Moscow State Univ.). Zhur. Anal. Khim. 13, 709-15 (1958) Nov.-Dec. (In Russian)

A review of the literature on the analytical chemistry of hafnium is presented. (tr-auth)

7539

THEORETICAL AND EXPERIMENTAL ASPECTS OF ISOTOPE EFFECTS IN CHEMICAL KINETICS. Jacob Bigeleisen and Max Wolfsberg (Brookhaven National Lab., Upton, N. Y.). pp. 15-76 in "Advances in Chemical Physics, Volume I." I. Prigogine, ed. New York, Interscience Publishers, Inc., 1958. 420p.

Theory of the isotope effect on reaction rates is presented. Hydrogen isotope effects in gas reactions and in reactions in solutions are described. Carbon isotope effects in decarboxylation reactions are presented. The reaction coördinates, unimolecular reactions, and experimental methods are included. (W.L.H.)

7540

NUCLEAR MAGNETIC RESONANCE. Applications to Organic Chemistry. John D. Roberts. New York, McGraw-Hill Book Company, Inc., 1959. 124p.

This book is the outgrowth of some forty lectures in which it was attempted to explain the phenomenon of nuclear magnetic resonance absorption and the uses of high-resolution nuclear magnetic resonance spectroscopy to organic chemists whose background has often been deficient in nuclear and electromagnetic theory. The coverage is illustrative rather than comprehensive. (W.D.M.)

7541

RESEARCH IN ION EXCHANGE CHROMATOGRAPHY. (Issledovannya v Oblasti Ionoobmennoi Khromatografy.) Transactions of the Session on Applications of Ion Exchange Chromatography in Medicine and the Food Industries. Original Russian Text Published by Academy of Sciences, USSR Press, Moscow, 1957. New York, Consultants Bureau, Inc., 1958. 182p. $35.00.

Information is presented on the problems of the application of ion exchange resins in medicine and the food industries, as well as on some questions relating to the theory of the application of ion exchange chromatography. Discussions are included on the following: laminar method for approximate calculation of chromatograms; equations for ion exchange isotherms and their experimental verification; the absorption of the cations of heavy metals by anion exchange resins; principles of adsorption technology; laws of adsorption from solutions under dynamic conditions during separation of alkaloids by means of ion exchange resins; ion exchange of alkaloids on synthetic ion exchange resins; the structure of cation exchange resins and their suggested chemical structure and possible breakdown products; basic problems in the synthesis and study of ion exchange resins; the physicochemical properties of ion exchange resins; the properties of some anion and cation exchange resins and the possibility of using them in the medical and food industries; the purification of certain chemical compounds by means of ion exchange sorbents; the possibility of using ion exchange resins for obtaining drinking water from water of high mineral content; the purification of lactic acid by means of ion exchangers; methods for isolating anabasine, spherophysine, and methyl caffeine from plant raw material and mother liquors by means of ion exchangers; elution curves of morphine during ion exchange chromatography on cation exchangers; the application of ion exchanger adsorbents in pharmaceutical analysis; the adsorption of streptomycin by the hydrogen and hydrogen salt forms of carboxylic cation exchangers; the use of ion exchange sorbents for preventing blood clotting; and the separation of cadmium and copper, cadmium and lead, and cadmium and bismuth by ion exchange chromatography. (J.H.M.)

Radiation and Radiochemistry

Refer also to abstract 8415.

7542 AERE-C/R-2776

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

ISOTOPIC ANALYSIS OF PLUTONIUM AND URANIUM BY MASS SPECTROMETER. A. H. Turnbull and D. F. Dance. Dec. 1958. 8p.

The techniques used for isotopic analysis of plutonium and uranium by means of the Metropolitan-Vickers Type MS5 mass spectrometer are described. The sensitivity and the accuracy which can be achieved are discussed. (auth)

7543 APEX-451

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

ISOTOPIC ANALYSIS OF URANIUM BY THE EMISSION SPECTROGRAPH. (Cover carries title: MODERN APPROACHES TO ISOTOPIC ANALYSIS OF URANIUM.) R. E. Kupel and W. Tichy. Jan. 17, 1957. Decl. Feb. 28, 1957. 16p. (XDC-57-1-78). $3.30(ph), $2.40 (mf) OTS.

Graphite electrodes were loaded with an equal mixture of graphite and uranium and excited in an a-c arc. The resulting spectra were monitored to obtain the relative intensities of the 4244.37 and the 4261.51 A lines. The ratio of the relative intensities of these two lines was then applied to a concentration curve, and the percent U^{238} was obtained. A known weight of sample was dissolved in HNO_3, evaporated on a disk, and the alpha activity determined. The U^{234} was calculated from the alpha count. The U^{235} was then obtained by difference, assuming that only the three isotopes are present. The accuracy compares favorably with the mass spectrometer method. The precision at the 95% confidence level is ±0.30%. (J.R.D.)

7544 CEA-tr-R-249

ACTION DU RAYONNEMENT γ DU ^{60}Co SUR LES SOLUTIONS AQUEUSES CONCENTRÉES DE CHLORURE DE POTASSIUM. (Effect of Co^{60} γ Rays on Concentrated Aqueous Solutions of Potassium Chloride.) A. M. Kabaktchi. Translated into French from Zhur. Fiz. Khim. 30, 1906-7(1956). 9p.

The effect of gamma radiation on concentrated aqueous solutions of potassium chloride saturated with air, oxygen, or nitrogen was studied. During the experiments particular emphasis was placed on the purity of the reagents used. The concentration of free chlorine was determined with methyl orange. It was shown that in 1 to 4 M solutions sufficient chlorine was formed to be detected with certainty after a dose of 2.0×10^{17} ev/cm^3. Up to 1.0×10^{18} ev/cm^3, the quantity of chlorine formed is a linear function of the dose received. No chlorine could be detected in 0.1 M solutions. The chlorine yield also depends on the gas saturating the solution. (J.S.R.)

7545 CEA-tr-R-553

DÉTERMINATION POLAROGRAPHIQUE SIMULTANEÉ DE L'OXYGENE ET DE L'ÉAU OXYGÉNÉE AU COURS DU PROCESSUS DE LEUR FORMATION SOUS L'ACTION DES RAYONNEMENTS. (Simultaneous Polarographic Determination of Oxygen and Hydrogen Peroxide During Their Formation by the Action of Radiation.) V. I. Medvedovskii (Medvedovsky). Translated into French from Zhur. Fiz. Khim. 32, 932-4(1958). 9p.

A method which permits the polarographic determination of hydrogen peroxide concentration only a few seconds after the start of irradiation is described. A polarographic cell for the simultaneous determination of oxygen and hydrogen peroxide formed during irradiation was designed and built. A sample polarograph obtained with this instrument is given. (J.S.R.)

7546

RAPID MODIFIED METHOD OF C^{14} DETERMINATION. Jiri Horacek and Dezider Gruenberger. Chem. listy 51, No. 10, 1944-6(1957). (Translated from Referat. Zhur. Khim. No. 22, 1958, Abstract No. 73178.)

A somewhat modified analytic method of combustion was applied to prepare standard samples of $BaCO_3$ from tagged organic compounds. Nitrogen oxides were absorbed by MnO_2 on silica gel. CO_2 was absorbed by NaOH solution in an absorber of a new construction. The total amount of absorbed CO_2 was determined by titration; the specific activity was determined by measuring $BaCO_3$ precipitated from the solution. The determination of the specific activity is reproducible. The combustion equipment is not contaminated with radiocarbon.

7547

THE FORMATION OF POLYMERS DURING THE IRRADIATION OF 2,4,4-TRIMETHYL-1-PENTENE. M. Grabriel de Gaudemaris. Compt. rend. 247, 2131-4 (1958) Dec. 10. (In French)

A high dose of electron irradiation of 2,4,4-trimethyl-1-pentene produces, with a radiochemical yield G = 6.5, well-defined polymers. The speed of the polymerization is bound to the dose administered by a relation of the order of 1, the relation being verified with good precision. The dimer and trimer, easily separated, are obtained selectively. (tr-auth)

7548

KINETIC STUDY OF THE RADIOCHEMICAL OXIDATION OF CYCLOHEXANE IN THE LIQUID PHASE. Monique Brun and Roger Montarnal. Compt. rend. 247, 2361-4(1958) Dec. 22. (In French)

The radiochemical oxidation of cyclohexane in the liquid phase proceeds by a classical chain reaction with characteristics easy to determine because of the independence between the initial step and the later steps. The law $I^{1/2}$ was verified, the activation energy of propagation was measured, certain characteristics of the chain reaction were calculated, and the effect of very radiosensitive solvents (sensitizers) was determined. (tr-auth)

7549

INVESTIGATIONS INTO THE DOMAIN OF THE RADIATION CHEMISTRY OF ORGANOMETALLIC COMPOUNDS. GAMMA RADIATIONS IN A REACTION OF METALLIC TIN WITH HALOGEN ALKYLS. L. V. Abramova, N. I. Sheverdina, and K. A. Kocheshkov (Karpov Research Inst. of Physics and Chemistry). Doklady Akad. Nauk S.S.S.R. 123, 681-4(1958) Dec. 1. (In Russian)

Interactions between γ-irradiated alkyl halides and metallic tin were studied. The reaction between alkyl bromides and tin takes place at standard temperatures with the yield up to 55 M per 100 ev, while RBr and tin form only traces of R_3SnX. The alkyl iodides react easily under irradiation with yields reaching 60 M per 100 ev. Correlations of published and obtained data show that alkyl chlorides and tin (in absence of catalyzer) do not form any tin-organic compound; under gamma irradiation or thermal interactions alkyl bromides form tin-organic compounds while alkyl iodides form tin-organic compounds in all mentioned interactions. (R.V.J.)

7550

THE EFFECT OF RADIOACTIVITY ON THE SORPTIVE PROPERTIES OF BARIUM SULFATE. V. I. Spitsyn and V. V. Gromov (Inst. of Physical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 123, 722-4(1958) Dec. 1. (In Russian)

Studies of the effects of radioactivity on the adsorption of $(C_{16}H_{11}O_4N_4S)Na$, $(C_{16}H_{18}N_3S)Cl$, and $(C_{27}H_{35}N_2)Cl$ on $BaSO_4$ (labeled with S^{35}) showed a much higher order of $BaSO_4$ residue adsorption of methyl orange than any other dye indicator. However, the adsorption of methyl blue is somewhat higher than that of brilliant green. (R.V.J.)

7551

USE OF ELECTRON PARAMAGNETIC RESONANCE IN THE INVESTIGATION OF FREE RADICALS FORMED ON THE IRRADIATION OF OXALIC ACID. Yu. N. Molin, A. T. Koritskii, N. Ya. Buben, and V. V. Voevodskii (Inst. of Chemical Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 124, 127-8(1959) Jan. 1. (In Russian)

Data are presented on the properties of radicals in oxalic acid irradiated by 1.6-Mev electrons. (R.V.J.)

7552

APPLICATION OF RADIOISOTOPES IN PLASTIC AND GLASS TECHNOLOGY. Muzhini Mikhailku. Ind. usoară (Bucharest) 4, No. 2, 68-72(1957). (Translated from Referat. Zhur. Khim. No. 16, 1958, Abstract No. 55717.)

The action of radioisotope radiation on monomers and polymers is described, as well as the application of radioactive isotopes in rubber vulcanization, polymerization of polyvinyl chloride, studies of the effect of sodium hydroxide on glass, systematic investigation on Ca and Pb silicates, determination of B in glass, and devices used to determine and regulate the charge level in glass furnaces.

7553

NEPTUNIUM AND PLUTONIUM. James C. Hindman (Argonne National Lab., Lemont, Ill.). J. Chem. Educ. 36, 22-6(1959) Jan.

Some aspects of the solid state and solution chemistry of Np and Pu are summarized. The metals in their metallic state are described, and some physical properties of Pu are listed. Discussions are included on Np and Pu oxides and halides and oxidation potentials, complex ion equilibria, and reactor kinetics of Np and Pu. (J.H.M.)

7554

AMERICIUM AND CURIUM. Thomas K. Keenan (Los Alamos Scientific Lab., N. Mex.). J. Chem. Educ. 36, 27-31(1959) Jan.

The chemistry of americium and curium is discussed, and methods for producing these elements are reviewed. Americium shows reactions typical of a highly electropositive metal and is capable of existing in solution as a hydrated trivalent ion or as a doubly oxygenated (V) or (VI) ion. Tetravalent americium can exist in certain solid compounds but has never been found in acid solution because of its ability to oxidize water or undergo disproportionation. The solution chemistry of the (V) and (VI) states of Am is complicated by the self-reduction of the ion concerned and has not been examined thoroughly. It has not been possible to attain any oxidation state of curium other than (III) in solution although a (IV) state can exist in the solid. The use of curium-244 (which has a 17.9 year half life) enabled certain new discoveries to be made in curium chemistry which probably never would have been possible with extremely active curium-242. (J.H.M.)

7555

BERKELIUM AND CALIFORNIUM. B. B. Cunningham (Univ. of California, Berkeley). J. Chem. Educ. 36, 32-7(1959) Jan.

A brief review of the discovery and formation of berkelium and californium is given. Isotopes Bk^{243} and Cf^{245}, plus those prepared since the initial discovery, are listed. The tabulation includes information on half life, mode of disintegration, and source. Discussions are presented on chemical properties of the elements, chemical investigations by tracer techniques, and isotopic composition. (J.H.M.)

7556

THERMAL ANNEALING OF CHEMICAL RADIATION DAMAGE. A. G. Maddock and S. R. Mohanty (University Chemical Lab., Cambridge, Eng.). Nature 182, 1797(1958) Dec. 27.

Experiments were conducted on the isothermal annealing of radiolyzed lead nitrate. Vacuum-dried lead nitrate crystals sieved to between 80 and 100 mesh were irradiated to a dose of about 50 Mr with 2-Mev electrons. A plot of the disappearance of the nitrite, produced by the irradiation, upon thermal annealing of the crystals is shown. (J.H.M.)

7557

EFFECTS OF GAMMA-RADIATION ON SOME CARBOHYDRATES, HYDROXYACIDS AND AMINO-ACIDS IN AQUEOUS SOLUTIONS. S. A. Barker, P. M. Grant, M. Stacey, and R. B. Ward (Univ. of Birmingham, Eng.). Nature 183, 376-7(1959) Feb. 7.

An investigation was made of the effect of a 200-c cobalt-60 source on dilute aqueous solutions of carbohydrates, hydroxyacids, and amino acids. It was found that in the absence of oxygen (that is, in vacuo or under nitrogen), radicals derived from these compounds exhibit a strong tendency to dimerize and that prolonged irradiation produces polymeric materials. The results are shown in tabular form and indicate the potentials of mixed solute irradiations in vacuum for forming radical addition products and the readiness which polymers can be formed. (J.H.M.)

7558

EFFECT OF THERMAL NEUTRON IRRADIATION ON OXIDE CATALYSTS FOR THE DECOMPOSITION OF NITROUS OXIDE. Yasukazu Saito, Yukio Yoneda, and Shoji Makishima (Univ. of Tokyo). Nature 183, 388-9 (1959) Feb. 7.

Radiation effects on the catalytic activities of nickel oxide, aluminum oxide, and stannic oxide are reported. Results of the investigation indicate the following catalytic changes: a small decrease with the nickel oxide system, an increase or decrease with the aluminum oxide system, and a remarkable increase with the stannic oxide system. Also, the results show that the larger the number of lattice defects, the more active is the semiconductor catalyst. (J.H.M.)

7559

COLORIMETRIC ANALYSIS OF RADIOACTIVE SOLUTIONS. G. P. Kitt and J. H. Moss (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Power 4, 90(1959) Feb.

In connection with the development of a process for the separation of Cs^{137} and Sr^{90} from mixed fission products, it was necessary to analyze solutions containing up to 100 millicuries of β and γ activity for trace quantities of Al, Fe, W, and Pb. The construction of a cell for carrying out the analyses is described. (W.L.H.)

7560

RADIATION-INDUCED CHANGES OF DIMENSIONS, INDEX OF REFRACTION, AND DISPERSION OF LITHIUM FLUORIDE. William Primak (Argonne National Lab., Lemont, Ill.). Phys. Rev. 112, 1075-83(1958) Nov. 15.

Deuteron, electron, gamma ray, and x-ray irradiated specimens were examined by a photoelastic method and by interferometric methods. In addition to the increase in physical dimensions, there were found an increase in refractive index and an increase in dispersion, and these were measured. The results agree with the classical dispersion formulas if it is assumed that the effects are caused by a change in the refractivity of the base material due to the introduction of vacancies and holes and a change in the refractivity due to the F centers and the 450 centers, the size of the vacancies being about that of the absent ions and the oscillator strength of the F centers being near unity. (auth)

7561

NUCLEAR RADIATION AS A REACTION INITIATOR. J. F. Black (Esso Research and Engineering Co., Linden, N. J.). Research (London) 11, 419-24(1958) Nov.

A brief summary is given of the chemical effects from nuclear radiation, and information is presented on some possible applications of different radiation sources in the production of polymers, the modification of polymer properties, and the activation of catalysts. (J.H.M.)

7562

A COMPLEXOMETRIC DETERMINATION OF THORIUM IN THE PRESENCE OF CERIUM. Lupan. Rev. chim. (Bucharest) 9, No. 2, 101-2(1958). (Translated from Referat. Zhur. Khim. No. 21, 1958, Abstract No. 70541.)

A small amount of Th^{4+} (1 to 20 mg) in the presence of a considerable amount of Ce^{3+} (up to 500 mg) is determined by titration with a complexone III solution in a

hydrochloric acid medium using pyrocatechin violet as the indicator. A weighed amount of the Th and Ce oxides separated prior to the analysis are dissolved by heating in HCl with the addition of 0.01 to 0.2 g of KI. The solution is evaporated to dryness, and the residue is dissolved in 0.5 ml of concentrated HCl. The solution is diluted with water to 50 ml. To that, 10 to 20 ml of C_2H_5OH is added and the solution is boiled until colorless Ce^{4+} is reduced to Ce^{3+}, cooled and diluted with water to 250 ml. To that, 4 to 5 drops of 0.1% pyrocatechin violet is added, and the solution is titrated with 0.01 complexone solution until the color is changed from pink to yellow. One ml of 0.01 N Complexone III solution corresponds to 0.00264 g of ThO_2. The CeO_2 is determined by its various forms. La, Pr, and Nb do not interfere with the determination.

7563

SYMPOSIUM ON RADIATION CHEMISTRY. Academy of Sciences of the USSR, Division of Chemical Science, Moscow, 1955. N. A. Bakh, ed. New York, Consultants Bureau, 1956. 229p. $100.00.

Papers devoted to the results of experimental investigations on radiation chemistry, carried out in the USSR in recent years, are presented. The papers are divided into two parts: those relating to transformations in aqueous solutions and those relating to transformations in organic substances. (J.S.R.)

7564

EFFECT OF DISSOLVED OXYGEN ON THE RADIOLYSIS OF WATER BY THE ACTION OF X-RAYS. P. I. Dolin. pp. 1-14 in "Symposium on Radiation Chemistry."

The formation of hydrogen and hydrogen peroxide, and also the decomposition of the latter in water containing dissolved oxygen, hydrogen peroxide, and a mixture of hydrogen and oxygen, under the action of x rays was studied. A relationship was found between the formation of hydrogen and the dose and the oxygen concentration, by means of which it is possible to determine the initial yield and limiting pressure of hydrogen in relation to the oxygen concentration. The steady-state (equilibrium) concentration of hydrogen peroxide at different oxygen concentrations was measured. A study was made of the effect of H_2SO_4 and KOH concentration on the kinetics of hydrogen evolution and on the equilibrium hydrogen peroxide concentration in water containing dissolved oxygen and nitrogen during irradiation by x rays. A kinetic equation for the evolution of hydrogen in neutral and acid solution was derived, based on a proposed mechanism for the radiolysis of water and the effect of dissolved substances on it. This equation is in full agreement with the experimental results obtained. (auth)

7565

KINETICS OF THE REACTION OF H_2O_2 WITH H_2 IN AQUEOUS SOLUTION UNDER THE ACTION OF X-RAYS. P. I. Dolin. pp. 15-24 in "Symposium on Radiation Chemistry."

The reaction between H_2O_2 and H_2 in aqueous solution under the action of x rays was studied in the range of H_2O_2 concentrations from 5×10^{-5} to 1.15 M. Four kinetic regions were established in the above concentration range. The kinetic equations for each region were derived on the basis of proposed reaction mechanisms. For the first region (concentration $\leq 0.5 \times 10^{-3}$ M) the equation coincides with Allen and Hochanadel's equation, and for the third and fourth regions (concentration $\geq 10^{-2}$ M) with the Hart-Matheson equation. All four equations agree with empirical equations derived on the basis of the experimental results obtained. A quantitative relationship was established between the constants in the equation for the first region and the constants in the kinetic equation for hydrogen evolution during the radiolysis of water containing dissolved oxygen. By means of this relationship it is possible to use data on the reaction between H_2O_2 and H_2 to calculate the rate of hydrogen evolution during the radiolysis of water, up to limiting pressures. An agreement between the direct and reverse reaction kinetics in acid and alkaline solutions was established. (auth)

7566

INVESTIGATION OF THE MECHANISM AND KINETICS OF OXIDATION REDUCTION REACTIONS IN AQUEOUS SOLUTIONS UNDER THE ACTION OF RADIOACTIVE RADIATIONS. V. I. Veselovskii (Veselovsky), Ts. I. Zalkind, N. B. Miller, and N. A. Aladzhalova. pp. 25-33 in "Symposium on Radiation Chemistry."

The investigation of the action of γ radiation on oxidation–reduction systems, cerium sulfate and perchlorate, potassium dichromate, and potassium permanganate, which have a high oxidation potential, showed that the reduction–oxidation equilibrium is shifted in the direction of formation of the reduced forms under the action of γ radiation. Upon prolonged action of the radiation, all the oxidized form is converted into the reduced form, so that equilibrium between the oxidation–reduction system and the radiolysis products of water is not established. From the results on the effect of the gases saturating the solution on the yields of the reduction reactions it may be concluded that, in all the systems studied, reduction proceeds through the H radicals formed in the radiolysis of water. It is shown that no direct relationship exists between the potential of the system and the yield of the radiochemical reduction reaction. Ozone was formed in solutions containing oxygen in two of the systems studied. The formation of ozone in these systems, and its absence from the other two systems does not depend on the value of the oxidation–reduction potential. It is probably due to other properties of these systems, namely, the ability of dichromate ions and cerium perchlorate to form peroxide compounds. This hypothesis doubtless needs additional proof. The fact itself that ozone is formed in solutions under the action of radiations will, upon further investigation, undoubtedly assist detailed elucidation of the mechanism of radiochemical reactions. (auth)

7567

INVESTIGATION OF THE LAWS OF RADIOCHEMICAL HOMOGENEOUS AND HETEROGENEOUS FORMATION OF HYDROGEN PEROXIDE. V. I. Veselovskii (Veselovsky), N. B. Miller, and D. M. Shub. pp. 35-43 in "Symposium on Radiation Chemistry."

The reaction of hydrogen peroxide formation in dilute aqueous alkaline solutions under the action of γ radiation was studied. Particular attention was paid to a study of the effect of the surfaces of semiconductors (ZnO) on the excitation of the heterogeneous radiation process. It is shown that the reaction of hydrogen peroxide formation can be investigated by anode polarography, by means of which measurements may be made during irradiation of the system without interference with the course of the process. The yield of hydrogen peroxide in aqueous NaOH solution in the presence of oxygen is very low, ~1.7 equiv. per 100 ev. Up to doses

of $\sim 10^{20}$ ev/ml the kinetic curves were linear for the dosages used. Steady-state concentrations of the hydrogen peroxide formed were reached after relatively prolonged irradiation of the solutions (8 to 10 hours) and had the value $\sim 4 \cdot 10^{-4}$ M. The results showed that the radiolysis products of water may be separated by making use of the reaction of barium peroxide precipitation in aqueous alkali solutions under the action of β and γ radiations. Removal of the hydrogen peroxide into the precipitate inhibits the reverse reactions, which usually decrease the efficiency of the direct process, and makes it possible to attain a steady-state formation of hydrogen peroxide. The experimental results of a study of the effect of zinc oxide suspensions on the yield of the radiolysis products of water under the action of γ radiation show that a ZnO-sensitized reaction occurs, which leads to hydrogen peroxide formation. In the action of γ radiation on such systems in the presence of oxygen, the hydrogen peroxide yield is much greater (3 to 5 times) than the yield in the same solutions in the absence of ZnO. It is postulated that the increased hydrogen peroxide yield is due to effective participation of that part of the absorbed energy of the γ radiation which causes electronic excitation of the semiconductor zinc oxide. (auth)

7568

INVESTIGATION OF THE LAWS OF RADIOCHEMICAL HOMOGENEOUS AND HETEROGENEOUS DECOMPOSITION OF HYDROGEN PEROXIDE. V. I. Veselovskii (Veselovsky) and G. S. Tyurikov. pp. 45-9 in "Symposium on Radiation Chemistry."

The decomposition of hydrogen peroxide in concentrated ($\sim 80\%$) solutions under the action of γ radiation was studied. Particular attention was paid to a study of the influence of semiconductor (Fe_2O_3) surfaces on the excitation of the heterogeneous radiochemical process. The results obtained in the study of the homogeneous decomposition of hydrogen peroxide under the action of γ radiation showed that the yield of this reaction is hundreds of times as great as the yield of usual (nonchain) reactions; this makes it necessary to assume a chain mechanism for the radiochemical decomposition of concentrated hydrogen peroxide solutions. The decomposition rate of hydrogen peroxide increases considerably in the presence of a metallic oxidized iron surface (Fe/Fe_2O_3) in the solution. The rate of the radiochemical decomposition of hydrogen peroxide was shown to depend on the temperature. The yield of the homogeneous decomposition of nonstabilized hydrogen peroxide under the action of γ radiation at $t = 25°$ is ~ 300 molecules per 100 ev. In the presence of an oxidized iron surface this yield under the action of γ radiation increases 2.5 times. It is established that the relationship between the decomposition rate of nonstabilized hydrogen peroxide under the action of γ radiation and the radiation intensity is described fairly satisfactorily by the equation $v = k\sqrt{I}$ (v is amount of gas evolved and I is radiation intensity). A heterogeneous radiochemical sensitization mechanism is proposed to explain the established influence of semiconductors on the excitation of heterogeneous radiochemical reactions. (auth)

7569

FORMATION OF A HYDROGEN POTENTIAL ON A PLATINUM ELECTRODE BY THE ACTION OF γ-RADIATION. Ts. I. Zalkind and V. I. Veselovskii (Veselovsky). pp. 51-4 in "Symposium on Radiation Chemistry."

The formation of a hydrogen potential on a platinum electrode by the action of gamma radiation was studied. The apparatus used and the experimental conditions are described. The results showed that when gamma radiation acts on the system Pt/sulfuric acid solution, the electrode potential assumes the value of the hydrogen electrode potential as the result of preferential hydrogen atom adsorption on the electrode surface. (J.S.R.)

7570

MEASUREMENT OF THE OXIDATION REDUCTION POTENTIAL OF A SYSTEM DURING IRRADIATION. V. I. Medvedovskii (Medvedovsky), N. A. Bakh, and E. V. Zhuravskaya. pp. 55-61 in "Symposium on Radiation Chemistry."

A technique for the measurement of the oxidation-reduction potentials of solutions under the action of high-power x radiation was developed. The change of potential in irradiated solutions of iron salts in sulfuric, perchloric, and nitric acids was measured. It is shown by comparison with model solutions that in the case of H_2SO_4 and $HClO_4$ the potential is determined by the ratio $[Fe^{3+}]/[Fe^{2+}]$. In solutions of Fe^{2+} in HNO_3, the radiochemical conversion products of the NO_3^- ion significantly affect the value of the potential. The difference between the course of the oxidation-reduction potential in HNO_3 and $HClO_4$ solutions rises sharply with increasing concentrations. (auth)

7571

THE OXIDATION REACTION OF BIVALENT IRON IONS IN AQUEOUS SULFURIC ACID SOLUTION UNDER THE ACTION OF γ-RADIATION. M. A. Proskurnin, V. D. Orekhov, and A. I. Chernova. pp. 63-7 in "Symposium on Radiation Chemistry."

The oxidation of bivalent iron ions under the action of γ radiation from radioactive Co^{60} was studied for ferrous sulfate concentrations above 10^{-3} M and sulfuric acid concentrations up to 5.0 N. It was established that in the concentration range studied the yield of the oxidation process greatly increases with increase of Fe^{2+} ion and sulfuric acid concentration in the solution, rising to a certain limiting value, determined by the mechanism of the process, and equal to 63 equiv. per 100 ev. It is shown that, in definite conditions, the oxidation of Fe^{2+} ions under the action of radiations on the aqueous solution proceeds with the participation of excited molecules of water, and as a result the average consumption of energy for the oxidation of one Fe^{2+} ion decreases to a value determined by the value of the excitation energy for a water molecule in the solution. (auth)

7572

THE ACTION OF γ-RADIATION OF THE DYE METHYLENE BLUE IN AQUEOUS SOLUTION. V. D. Orekhov, A. I. Chernova, and N. A. Proskurnin. pp. 69-73 in "Symposium on Radiation Chemistry."

The action of γ radiation on acidified aqueous solutions of methylene blue was studied in various conditions. It is shown that in an inert atmosphere an aqueous solution of the dye containing glucose is decolorized during irradiation, owing to reversible reduction by hydrogen atoms with the consumption of 2 atoms for each dye molecule. It is established that an aqueous methylene blue solution protected against the action of the reducing products of the radiolysis of water (hydrogen atoms) by the addition of an excess of Fe^{3+} ions, is irreversibly decolorized as the result of oxidation by free hydroxyls. Two OH radicals are used in the oxidation of one dye molecule. It is established that an aque-

ous methylene blue solution not containing protective substances is oxidized in an inert atmosphere as the result of simultaneous reduction and oxidation reactions with the radiolysis products of water, namely, hydrogen atoms and free hydroxyls. It is shown that the oxygen present in the dye solution acts as a protective substance during irradiation in air, by combining with the reducing components of the radiolysis products of water. The HO_2 radicals formed in the process react with some of the free hydroxyls, so lowering the dye oxidation yield. (auth)

7573

THE ACTION OF γ-RADIATION ON AQUEOUS SOLUTIONS OF POTASSIUM NITRATE AND NITRATE. V. D. Orekhov, A. I. Chernova, and M. A. Proskurnin. pp. 75-81 in "Symposium on Radiation Chemistry."

The action of γ radiation on aqueous potassium nitrate and nitrite solutions was studied. The radiochemical conversion of nitrate ions in aqueous solution consists of their reduction to nitrite ions by hydrogen atoms formed in the radiolysis of water. The presence of molecular oxygen in the solution does not affect the course of the process. The initial yield of the nitrate reduction process is about 2 molecules/100 ev. This value persists even at high doses (>200 kiloroentgen) in alkaline solutions, while in acid solutions the yield of nitrite formation falls rapidly to zero with increase of the dose. Irradiation of potassium nitrite solutions causes oxidation of nitrite ions to nitrate ions by the free hydroxyls formed in the radiolysis of water. The rate of the process is proportional to the nitrite concentration in the solution. It is low in alkaline solutions, and fairly high in acid solutions. This is the reason for the decrease in the yield of nitrate reduction to nitrite in irradiation of acid solutions. When aqueous solutions of alkalies are irradiated in an air atmosphere, atmospheric nitrogen is combined by means of a radiochemical reaction with formation of nitrite and nitrate. The yield of this process is about 0.1 molecule/100 ev, and is independent of the alkali concentration in the pH range 9.0 to 14.0, and of the air pressure up to 25 atmospheres. The addition of glucose to alkaline potassium nitrate solution creates conditions in which two conjugate radiochemical reactions can occur with the participation of excited water molecules. This results in a greater utilization of the absorbed radiation energy. The yields of these processes reach values over 12 equiv. per 100 ev, which cannot be explained by the participation only of the radicals formed by ionization of water molecules. (auth)

7574

SENSITIZATION OF THE RADIOLYTIC OXIDATION OF BENZENE. M. A. Proskurnin and E. V. Barelko. pp. 83-8 in "Symposium on Radiation Chemistry."

Iron ions were found to sensitize the radiolytic oxidation of benzene to phenol by the radiolysis products of water and oxygen. The optimum sensitization conditions were found, in which the yield of phenol reaches the maximum theoretical value, 6 molecules/100 ev. An explanation for the sensitization effect is proposed, by a mechanism with the participation of free HO_2 radicals. It is shown that increased oxygen pressure does not result in any significant increase of the phenol yield. (auth)

7575

THE OXIDATION OF ORGANIC COMPOUNDS. M. A. Proskurnin, E. V. Barelko, and L. V. Abramova. pp. 89-92 in "Symposium on Radiation Chemistry."

The radiation oxidation of butyl alcohol–oxygen–water and benzyl alcohol–oxygen–water systems was studied. The effect of the integral dose on the amounts of oxidation products formed was investigated. The hydrogen peroxide yield is the same with either butyl and benzyl alcohol present in the water. The aldehyde yield in the case of butyl alcohol and the sum of the aldehyde and acid yields in the case of benzyl alcohol solutions are approximately the same, 3 to 4 molecules/100 ev. The phenolic compound was formed in much lower yield in the benzyl alcohol. (J.S.R.)

7576

THE EFFECT OF X-RAYS ON THE STABILITY OF METAL OXIDE SOLS. I. $Fe_2O_3-Cr_2O_3-Al_2O_3$. E. M. Nanobashvili and N. A. Bakh. pp. 93-101 in "Symposium on Radiation Chemistry."

The effects of x radiation on the stability of ferric oxide, chromium oxide, and aluminum oxide sols were studied. Disturbance of the stability of the sols is caused by radiochemical oxidation-reduction reactions which take place between the stabilizing complexes on the particle surfaces and the hydrogen atoms or hydroxyl radicals formed in the intermicellar liquid in the sol by the action of radiation on water. In the absence of oxidation-reduction reactions capable of altering the surface condition of the particles and therefore the particle charge, as in the case of aluminum oxide, the sols retain their stability after the absorption of very considerable amounts of energy. (auth)

7577

THE EFFECT OF X-RAYS ON THE STABILITY OF METAL OXIDE SOLS. II. $MnO_2-V_2O_5-SnO_2-CeO_2-TiO_2-ThO_2-SiO_2$. E. M. Nanobashvili and N. A. Bakh. pp. 103-9 in "Symposium on Radiation Chemistry."

An investigation of the behavior of MnO_2, V_2O_5, SnO_2, CeO_2, TiO_2, ThO_2, and SiO_2 hydrosols under the action of x rays showed that stability may be either destroyed or retained, both in positive and in negative sols. An examination of the possible oxidation-reduction reactions in the sols under the action of radiation, and consideration of the course of these reactions in relation to changes in the sol stability, leads to the conclusion that the presence or absence of coagulation on irradiation is determined by the presence or absence of radiochemical reactions affecting the stabilizing complexes on the sol particle surfaces and causing changes of charge. In this respect hydroxide sols may be divided into three classes. Sols of the oxides of elements which exist in only one valency state, and which therefore cannot take part in oxidation-reduction reactions are quite insensitive to radiation even in very large doses. Examples of these are positively charged aluminum oxide sols and negatively charged silicic acid sols. Sols of oxides of elements of variable valency, in which the stabilizing complexes participate in oxidation-reduction reactions are a second type. If the particle charge is determined by the oxide in the highest valency state, radiation causes reduction, and as a result the charge is decreased and rapid coagulation occurs. Such systems are represented by positive ferric oxide and cerium dioxide sols, and negative manganese dioxide, vanadium pentoxide, and tin dioxide sols. If the particle charge is determined by a complex in the lowest valency state, irradiation causes oxidation. In the case of

the positive chromium oxide sol this does not result in loss of stability. Sols of oxides of elements capable of forming stable peroxide compounds are the third type. If insoluble peroxide compounds are formed with the participation of the stabilizing complexes, there is a sharp decrease of the surface charges on the particles. Such systems are represented by the positive thorium dioxide sols, which is readily coagulated by the action of radiation, although it does not exhibit variable valency. Peroxide compounds may also be formed without loss of stability if they do not produce a change in the charge, as in the case of the positive titanium dioxide sol. In all instances the formation of reduction or oxidation products under the action of radiation was established analytically, mainly by polarographic methods, and it was shown that rapid coagulation begins at doses at which the radiochemical conversions reach a steady state. The maximum decrease of ζ potential corresponds to the same doses. For coagulating sols, these doses lie in the range 3×10^{19} to 6×10^{19} ev/ml. The doses attained for noncoagulating sols were an order of magnitude higher. (auth)

7578

FORMATION OF OZONE IN LIQUID OXYGEN UNDER THE ACTION OF HIGH-SPEED ELECTRONS. S. Ya. Pshezhetskii (Pshezhetsky), I. Ya. Myasnikov, and N. A. Buneev. pp. 111-17 in "Symposium on Radiation Chemistry."

The reaction of ozone formation in the bombardment of liquid oxygen by high-speed electrons with energy of the order of 100 to 200 kv was studied. The amounts of ozone formed for different irradiation times and current strengths were measured. The dilution of oxygen with nitrogen does not appreciably affect the amount of ozone formed. An approximate calculation of the reaction yield shows 10 to 15 molecules of O_3/100 ev of absorbed energy. The probable mechanism of ozone formation under electron bombardment is discussed. (J.S.R.)

7579

OXIDATION OF ORGANIC COMPOUNDS BY MOLECULAR OXYGEN UNDER THE ACTION OF IONIZING RADIATIONS. I. FORMATION OF PEROXIDE COMPOUNDS IN LIQUID HYDROCARBONS. N. A. Bakh. pp. 119-27 in "Symposium on Radiation Chemistry."

The formation of peroxide compounds in hydrocarbons of various structures by molecular oxygen under the action of x rays and electron bombardment was studied. It is shown that in n-heptane, isooctane, and toluene, peroxides of the types R_1OOR_2, ROOH and H_2O_2, in cyclohexane, R_1OOR_2 and ROOH, and in benzene, only R_1OOR_2 and H_2O_2 are formed. It is established that the radiochemical yield of these compounds does not exceed 1 to 2 molecules/100 ev. The mechanism of their formation is discussed. (auth)

7580

OXIDATION OF ORGANIC COMPOUNDS BY MOLECULAR OXYGEN UNDER THE ACTION OF IONIZING RADIATIONS. II. FORMATION OF STABLE OXIDATION PRODUCTS IN HYDROCARBONS OF DIFFERENT STRUCTURE. N. A. Bakh and N. I. Popov. pp. 129-34 in "Symposium on Radiation Chemistry."

The formation of nonperoxide oxidation products in the liquid phase by the action of x rays and electron bombardment on hydrocarbons in the presence of molecular oxygen was studied. In n-heptane, isooctane, and cyclohexane, carbonyl compounds in yield of 2, 1.2, and 0.6 molecules/100 ev, and acids in yields of 0.4, 0.6, and 0.2 molecules/100 ev, respectively, are formed. In benzene under the same conditions phenol, in a yield of 0.6 molecule/100 ev, and an aldehyde, in a yield of 0.45 molecule/100 ev, are formed; acids were not detected in benzene. Within the limits of the experimental errors, the radiation yield of all the substances studied does not depend on the temperature or the dose intensity. A possible mechanism for the oxidation processes, based on radical nonchain reactions, is discussed. (auth)

7581

OXIDATION OF ORGANIC COMPOUNDS BY MOLECULAR OXYGEN UNDER THE ACTION OF IONIZING RADIATIONS. III. OXIDATIVE RADIOLYSIS OF ETHYL ALCOHOL. N. A. Bakh and Yu. I. Sorokin. pp. 135-44 in "Symposium on Radiation Chemistry."

The action of electron bombardment and x irradiation on ethyl alcohol in the presence and absence of molecular oxygen was studied. Radiolysis of deaerated alcohol results in the formation of acetaldehyde, water, hydrogen, methane, and carbon monoxide, the aggregate yield of these compounds being ~9 molecules/100 ev. In the presence of molecular oxygen the yield of these products increases sharply (for example, from 6 to 12 molecules/100 ev in the case of hydrogen), and peroxides and an acid also appear. The aggregate yield exceeds 25 molecules/100 ev. Variations of the temperature and dose intensity affect the relative yields of aldehyde and acid in presence of O_2, but does not affect their aggregate yield. There are no significant differences between the action of an electron stream and x radiation. A mechanism for the formation of the compounds found is proposed, according to which molecular dehydrogenation with formation of acetaldehyde and ketene predominates in absence of oxygen, while in presence of oxygen radical reactions also occur, which commence with the capture of CH_3CHOH radicals by molecular oxygen. (auth)

7582

OXIDATION OF ORGANIC COMPOUNDS BY MOLECULAR OXYGEN UNDER THE ACTION OF IONIZING RADIATIONS. IV. OXIDATIVE RADIOLYSIS OF ACETIC ACID. N. A. Bakh and V. V. Saraeva. pp. 145-51 in "Symposium on Radiation Chemistry."

The effect of x radiation on acetic acid in the presence and absence of molecular oxygen was studied. A comparison of the total yields of the products formed in the presence and absence of oxygen shows them to be very similar (6.2 and 5.9 molecules/100 ev, respectively). The products formed in the radiolysis are hydrogen peroxide, acetyl hydroperoxide, acetyl peroxide, methyl hydroperoxide, formaldehyde, acetone, and carbon dioxide. A mechanism for the formation of the compounds found is proposed. (J.S.R.)

7583

REDISTRIBUTION OF ABSORBED ENERGY IN RADIATION POLYMERIZATION. T. S. Nikitina and Kh. S. Bagdasaryan. pp. 153-64 in "Symposium on Radiation Chemistry."

A study was made of the polymerization kinetics of methyl methacrylate, styrene, and vinyl acetate in bulk, and in mixtures with ethyl acetate, benzene, and carbon tetrachloride under the action of γ radiation from Co^{60}. The yields of primary radicals initiating polymerization per 100 ev of absorbed energy were determined. For mixtures of styrene and methyl methacrylate with car-

bon tetrachloride, the curves for the polymerization rate as a function of the composition of the mixture pass through a maximum. It is shown that curves of this type cannot be interpreted on the assumption of the independent formation of primary radicals from the components of the mixture. A general equation was derived for the yield of primary radicals in two-component mixtures, with consideration of the radiochemical redistribution of the absorbed energy. The equation which was derived for the primary radical yields is in good agreement with experimental data on monomer polymerization in mixtures. The equation for the primary radical yield can also be applied to other radiochemical reactions in organic mixtures. (auth)

7584

STUDY OF CHEMICAL CHANGES IN POLYMERIC SUBSTANCES UNDER THE INFLUENCE OF IONIZING RADIATIONS BY THE VIBRATIONAL SPECTRUM METHOD. I. ACTION OF HIGH SPEED ELECTRONS ON POLYETHYLENE. N. A. Slovokhotova and V. L. Karpov. pp. 165-73 in "Symposium on Radiation Chemistry."

An investigation of the vibrational spectra of polyethylene showed that deep changes in the chemical structure of polyethylene occur during irradiation by high-speed electrons: carbon–carbon double bonds are formed, chain branching increases, and the polyethylene passes from the crystalline into the amorphous state. When irradiated in air, polyethylene is oxidized, with the formation of various types of carbonyl and ether groups. (auth)

7585

STUDY OF CHEMICAL CHANGES IN POLYMERIC SUBSTANCES UNDER THE INFLUENCE OF IONIZING RADIATIONS BY THE VIBRATIONAL SPECTRUM METHOD. II. ACTION OF γ-RADIATION ON POLYETHYLENE. N. A. Slovokhotova and V. L. Karpov. pp. 175-81 in "Symposium on Radiation Chemistry."

A scheme for the processes which occur in polyethylene under the action of ionizing radiations is proposed, based on the presence, in the infrared spectra of irradiated polyethylene, of absorption bands characteristic of increased branching and of the presence of cross-linked molecules, and also of the presence of various C = C double bonds and hydroxyl, carbonyl, and carboxyl groups. The chemical changes which occur in polyethylene under the action of ionizing radiations may be explained by interactions of the free radicals which are formed in the polyethylene during irradiation. Recombination of the radicals leads to branching of the polyethylene molecular chains and to formation of cross-linked molecules. Depolymerization of the radicals leads to formation of unsaturated molecules; the molecules with double bonds at the end of the chain formed in the process again readily participate in polymerization reactions with the free radicals. When polyethylene is irradiated in air, oxygen may be added at the double bonds formed during irradiation, to form carbonyl compounds. Oxygen activated during irradiation may also participate in the development of the reaction chains. Molecules containing hydroxyl, carbonyl, and carboxyl bonds may be formed by reactions between oxygen and the polyethylene molecules. (auth)

7586

DISORIENTATION PROCESSES IN CRYSTALLINE POLYMERS BY THE ACTION OF NUCLEAR RADIATIONS. V. L. Karpov and B. I. Zverev. pp. 183-9 in "Symposium on Radiation Chemistry."

The disorientation processes in crystalline polyethylene by the action of high-speed electrons and gamma radiation were investigated. A transition from the crystalline to the amorphous state takes place as the irradiation time increases. The clearest results were obtained with electrons, although with gamma radiation it is possible to follow the conversion process of polyethylene into the amorphous state down to much lower degrees of conversion. The change is irreversible; neither heat treatment nor prolonged storage at room temperature results in the restoration of the original crystalline structure. The mechanism of the transition from the crystalline to the amorphous state is discussed. (J.S.R.)

7587

IONIZATION AND DISSOCIATION OF SOME HALOGEN DERIVATIVES OF HYDROCARBONS BY THE ACTION OF ELECTRONS OF DIFFERENT ENERGY. N. N. Tunitskii (Tunitsky), S. E. Kurpiyanov, and M. V. Tikhomirov. pp. 191-205 in "Symposium on Radiation Chemistry."

The ionization and dissociation of methane and a number of halogenated hydrocarbons were studied. The influence of the number and nature of the halogen atoms in the molecule on the ionization and dissociation processes was established. Anomalous ions and certain secondary processes in ionization and dissociation were studied, and in particular the formation of H_2X^+ in the mass spectra of some halogenated hydrocarbons and a number of anomalous lines in the mass spectrum of 1,1-dichloroethane were found. The dependence of the nature of the ionization and dissociation of the molecules CH_3I, $C_2H_2Cl_4$, CH_3Br, and CH_3Cl on the electron energy up to 1100 V was investigated. It is shown that the mass spectra become impoverished in fragmentary ions as the ionizing electron energy increases. (auth)

7588

ACTION OF RADIOACTIVE RADIATIONS ON CCl_4 AND THE MIXTURES $CCl_4 + C_2Cl_6$, $CCl_4 + CBr_4$. A. V. Zimin and Z. S. Egorova. pp. 207-13 in "Symposium on Radiation Chemistry."

Irradiation of CCl_4, C_2Cl_6, C_6Cl_6, and CBr_4 with alpha particles, electrons, and gamma rays results in the formation of free halogen, which is one of the main primary products of radiolysis. The yield of free halogen greatly depends on the dose intensity and the integral radiation dose, the nature of the radiation, and the state of aggregation. The higher stability of C_2Cl_6, C_6Cl_6, and CBr_4 to the effects of radiations is probably the consequence of the molecular mass and structure. The free chlorine and bromine yields in the irradiation of a $CCl_4 + CBr_4$ mixture greatly depend on the ratio of the components, but the chlorine yields in $CCl_4 + C_2Cl_6$ is the same as if each component were irradiated separately. (auth)

7589

ACTION OF γ-RADIATIONS ON THE MIXTURES $NH_3 + C_6H_6$ AND $CCl_4 + C_6H_6$. A. V. Zimin, S. V. Churmanteev, and A. D. Verina. pp. 215-23 in "Symposium on Radiation Chemistry."

The action of γ radiation on liquid mixtures of $NH_3 + C_6H_6$, like the action of various types of electric discharge on gaseous mixtures, produces $C_6H_5NH_2$, the amount of which is determined by the ratio of the

amounts of the components present. The highest quantitative yield, 0.36 molecules per 100 ev, corresponds to a 1:1 molar ratio between NH_3 and C_6H_6. The action of γ radiation on liquid mixtures of $CCl_4 + C_6H_6$ produces $C_6H_5CCl_3$. The highest yield of $C_6H_5CCl_3$, 0.45 molecules/100 ev, was found with a molar ratio of 1:1 between the CCl_4 and C_6H_6. The presence of air in the irradiated mixture, as is also the case when a high frequency discharge is used, increases the yield of $C_6H_5NH_2$ from a gaseous mixture of $NH_3 + C_6H_6$. At low integral doses and in the presence of 0.12 to 0.14% air the maximum yield of $C_6H_5NH_2$ was obtained, 2 molecules per 100 ev. When the irradiated mixture contained CBr_4, the amount present being 2.5% of the total weight of the mixture, the maximum yield of $C_6H_5NH_2$ was ~1.6 molecules/100 ev, while when the irradiated mixture contained 11.2% by weight of C_2Cl_4, the maximum yield of $C_6H_5NH_2$ was ~0.85 molecule per 100 ev. Further increase of the amount of CBr_4 or C_2Cl_4 in the irradiated mixture does not increase the $C_6H_5NH_2$ yield. When the integral dose is increased from 2.9×10^{19} ev per 1 g of the irradiated mixture ($NH_3 + C_6H_6$ + air) to 18.5×10^{19} ev/g, the yield of $C_6H_5NH_2$ falls from 1.9 to 0.81 molecule/100 ev. (auth)

7590

REACTOR FUEL PROCESSING. Technical Progress Review, Vol. 2, No. 1. Lemont, Ill., Argonne National Laboratory, 1959. 56p. Available from U. S. Government Printing Office, Washington for $0.55 (domestic), $0.70(foreign).

Industry and research establishments were invited by AEC to perform research and development in any of six fuel-cycle development areas. Two accidents occurring during the quarter were described, one of which was the explosion of a Hanford nitrate reactor used to absorb iodine vapors, and the other was at Oak Ridge involving criticality. Methods of decladding and dissolving a wide variety of reactor fuels are under consideration. Mechanical methods such as rolling, milling, extrusion, abrasive cutting, electrical discharge cutting, and shearing are effective for unbonded or NaK bonded fuels. Only rolling and shearing appear applicable to metallurgically bonded fuels. Chemical dejacketing of fuel elements is an attractive alternate to mechanical processing or complete dissolution; the fuel cores thus exposed can be dissolved in another step. Various flowsheets for these methods are included. Improvements in the Purex and Redox processes are described. Improved decontamination in the Purex Process was realized by operation of one portion of the scrub at 30 and the other at 70°C, taking advantage of the temperature effect on the presence of Ru and Nb–Zr. Another method of Ru and Nb–Zr removal is the use of a silica-gel column. An alternate for the Redox solvent was found in hexone. A purex flowsheet was adapted to the recovery of U and Np from fluoride ash. Data were obtained for the criticality of U^{233} and U^{235} enriched uranyl fluoride solutions in cylinders, and the maximum dimensions of water-reflected infinite bodies are presented tabularly. A procedure for scavenging Ru from Purex uranyl nitrate solution is described, in which a decontamination factor of 35% was observed. The purification and recovery of Pu and Np by ion exchange are discussed. The electrolytic removal of Ru and nitrate ion from alkaline solutions is examined. Developments in continuous anion-exchange equipment are indicated. Information concerning various aspects of volatility processing are presented. Included is information on fused-salt processing of Zr alloys and ARE fuel, PuF_6 chemistry, large-scale F_2 production, studies of U ignition in interhalogens, and a process which combines aqueous dissolution and fluid-bed calcining with fluorination techniques. Homogeneous reactor fuel processing is being studied at several locations; the studies include processing of Pu-enriched fuel alloys and UO_2 processing. A section reviewing the progress of aqueous homogeneous reactor technology is presented. Corrosion is examined in relation to new process development and the processing of proposed fuels in existing plants. Several new instrument developments are described. A review of waste disposal given at the Second Geneva Conference is presented, along with a brief summary of the Fifth AEC Air Cleaning Conference. A review of the operating experience in waste disposal at various AEC sites is given along with a summary of reported work in specific phases, such as waste volume reduction, reduction of solids, removal of specific isotopes, and final disposal methods. Finally, a review of new developments in conversion of purified U, Pu, and Th salts to metals is presented. (J.R.D.)

Separation Processes for Pu and U

Refer also to abstracts 8350, 8351, 8360, 8361, 8367, 8371, 8377, 8383, 8385, 8395, 8384, 8402, 8403, 8412, 8418, 8419, 8420, 8429, 8431, 8434, 8435, 8438, 8440, 8441, 8442, and 8443.

7591 CF-58-5-33

Oak Ridge National Lab., Tenn.

AQUEOUS HOMOGENEOUS REACTOR FUEL PROCESSING—THE BEHAVIOR OF INSOLUBLE CORROSION AND FISSION PRODUCTS. P. A. Haas. May 31, 1958. 33p. Contract [W-7405-eng-26]. $6.30(ph), $3.00(mf) OTS.

For presentation at the American Chemical Society's Nuclear Technology Symposium, Boston, Apr. 5-10, 1959.

Information is presented from studies with materials and conditions simulating those expected in an aqueous homogeneous reactor for the formation of insoluble corrosion and fission products in aqueous UO_2SO_4 solutions used as a reactor fuel. Sulfate salts which become insoluble as the temperature increases deposited preferentially and reversibly on hot walls. Oxides from hydrolysis of sulfate salts deposit on any surfaces while insoluble corrosion products released into the solution show variable degrees of circulation. (auth)

7592 DP-192

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.

CONCENTRATION OF PLUTONIUM BY CATION EXCHANGE. PART I. NEW ELUTRIANTS. Oscar D. Bonner, Glenn A. Burney, and Frank W. Tober. Dec. 1956. Decl. Jan. 14, 1959. 16p. Contract AT(07-2)-1. $3.30(ph), $2.40(mf) OTS.

Over 99% of the total plutonium absorbed on a cation resin was eluted at an average concentration of 43.8 grams per liter by a solution of ammonium lactate plus ammonium sulfamate. This elutriant does not evolve gases in the resin bed. (auth)

7593 HW-38610(Del.)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

CORROSION STUDIES CONCERNING THE REDOX F-2

AND D-14 CONCENTRATORS—PHASE II OPERATION. N. D. Groves, M. C. Fraser, and W. L. Walker. Apr. 30, 1956. Decl. with deletions Feb. 3, 1959. 18p. Contract W-31-109-Eng-52.

A laboratory investigation of the potential corrosion problems incurred by the process changes was deemed necessary to provide a basis for estimating the expected service life of the Redox F-2 and D-14 concentrators. The three fold purpose of this laboratory study was to: establish the order of magnitude of the corrosion problem existing in the Redox F-2 and D-14 concentrators, provide preliminary indications of the most suitable material of construction for the replacement of these vessels, and indicate which area of investigation has the greatest potential for solving these corrosion problems. Samples of types 304L, 312, 347 stainless steels were exposed in the sensitized and as-welded conditions to synthetic anticipated Redox process solutions, both as heat transfer surfaces and as static total immersion specimens. Samples of Grade A-55 titanium were similarly exposed. The corrosion rates determined by these experiments indicate, a severe corrosion problem potentially exists in the Redox F-2 and D-14 concentrators, titanium exhibits corrosion rates two orders of magnitude less than the stainless steels tested, type 304L stainless steel welded with type 308L welding alloy exhibit the greatest corrosion resistance of the stainless steels tested, and solution composition has a greater effect on the corrosion rate than the differences between the stainless steels. (auth)

7594 HW-56752(Del.)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PRELIMINARY ZIRFLEX FLOWSHEET FOR THE DISSOLUTION OF ZIRCALOY CLAD FUELS. C. R. Cooley and A. M. Platt. July 10, 1958. Decl. with deletions Feb. 3, 1959. 7p. Contract W-31-109-Eng-52. $1.80 (ph), $1.80(mf) OTS.

A preliminary flowsheet for processing Zircaloy-clad uranium dioxide fuels is presented. The process (Zirflex) employs a mixture of boiling ammonium fluoride and ammonium nitrate for the selective dissolution of the fuel cladding. Most of the uranium dissolved during coating removal is precipitated as UF_4 by cooling. Centrifugation recovers the precipitate which is later dissolved in nitric acid and aluminum nitrate. After decladding the remaining cores of metallic uranium or uranium dioxide are dissolved in a conventional manner with nitric acid. Likewise, the customary stainless steel equipment may be used. Typical corrosion rates for cladding removal followed by nitric acid dissolution are 2.5 mils per month. (auth)

7595 ORNL-2182(Del.)

Oak Ridge National Lab., Tenn.

OXIDATION OF ZIRCONIUM-CONTAINING FUELS TO FACILITATE URANIUM RECOVERY. R. G. Wymer. Dec. 3, 1956. Decl. with deletions Jan. 20, 1959. 15p. Contract W-7405-eng-26.

Results of this investigation indicated that an oxidation-leaching process for uranium recovery from zirconium–uranium is not practicable. Oxidation of zirconium–uranium alloy specimens was sufficiently rapid that the elements would be completely converted to the oxides in about 6 hr at 1000°C. However, uranium recovery in leaching was of the order of 80% in the best cases. Tolerable losses are of the order of 0.05%. Oxidative processing of this type of fuel was therefore abandoned. (auth)

7596 ORNL-2591

Oak Ridge National Lab., Tenn.

LABORATORY DEVELOPMENT OF THE THOREX PROCESS. Progress Report [for] December 1, 1955 to January 1, 1958. R. H. Rainey, A. B. Meservey, and R. G. Mansfield. Feb. 27, 1959. 55p. Contract W-7405-eng-26. $1.50(OTS).

The Thorex process has been modified to increase decontamination so that thorium irradiated to more than 2000 g U^{233} per ton thorium and decayed less than 180 days may be recovered. Modifications include the conversion to a codecontamination flowsheet, sweep of I^{131} from the dissolver with iodine carrier, improved ruthenium decontamination by addition of bisulfite to the feed, addition of a U^{233} third-cycle solvent extraction, and improved solvent recovery by use of 0.2 M NaOH treatment. Activity remaining in products from pilot plant experiments processing thorium irradiated to 4000 g U^{233} per ton of thorium, decayed 27 days, by this modified process, exceeded tentative specifications by about a factor of two. (auth)

7597

EXTRACTION OF URANYL NITRATE BY DIETHYL ETHER FROM WATER–NITRIC ACID–AMMONIUM NITRATE SOLUTIONS. Josef Cepelák, Jaromír Malý, and Vojtech Machácek. Chem. listy 51, No. 2, 2195-9 (1957). (Translated from Referat. Zhur. Khim. No. 22, 1958, Abstract No. 73264.)

The equilibrium distribution of uranyl nitrate (I) between aqueous HNO_3 solution and diethyl ether (II) in the presence of NH_4NO_3 was established. The distribution was different at HNO_3 concentrations of 1 and 5 N. From the study of the equilibrium of absorption spectra of the two phases and of the course of the curve of the liquid-phase melting, it is assumed that at the extraction of I with II from 5 N HNO_3, uranium is in the aqueous phase as $U_2O_5^{2+}$, and in the organic phase it is as a complex with a $UO_2(NO_3)_3^-$ ion. The exact equation of the equilibrium reaction on the dividing interface of both the phases could not be determined because of the difficulty in the determination of HNO_3 bound with II and with I in the organic phase.

7598

INDUSTRIAL METHODS OF U^{235} ENRICHMENT. Kiss Istvan (State Research Inst., Dept. of Chemistry). Energia es Atomtech. 11, 466-73(1958). (In Hungarian)

Electromagnetic, centrifugal, gaseous diffusion, and gas jet separation methods of U^{235} are described. (R.V.J.)

7599

COMMERCIAL PRECIPITATION OF URANIUM WITH THE AID OF AMMONIUM SULFIDE. V. Logomerts. Glasnik Khem. Drushtva Beograd 21, No. 4, 251–4(1956). (Translated from Referat. Zhur. Khim. No. 20, 1958, Abstract No. 67978.)

In the commercial manufacture of U from ores a method employing sulfate for extraction is common. Better results are obtained when U is removed from the sulfate solution by precipitation with ammonium sulfide. A yield of U as high as 83% is thus obtained.

7600

URANYL-ION EXCHANGE RESIN REACTION AND DEMINERALIZATION. Walter E. Miller (City Coll., New York). Science 129, 465(1959) Feb. 20.

Complex ion formation on an ion exchange resin with one ion of an electrolyte results in the release of ex-

change sites which are then available for the sorption of the remaining ion. The result is a demineralization with but one ion exchange resin. The exchange capacity of the resin is limited by the nature of the complex formed. (auth)

CONTROLLED THERMONUCLEAR PROCESSES

Refer also to abstract 8448.

7601 AECD-3750
Princeton Univ., N. J. Project Matterhorn.
NOTE ON THE FUNCTION OF THE AQUADAG IN THE STELLARATOR. Technical Memorandum No. 5. Louis Witten. Jan. 14, 1953. Decl. Aug. 21, 1958. 12p. $3.30(ph), $2.40(mf) OTS.

Aquadag was introduced to serve two purposes; one to prevent the nonuniform accumulation of electrostatic charges on the walls of the stellarator and two to achieve a uniform field distribution around the stellarator. The second function is discussed in considerable detail and the problem is analyzed to a certain degree of completeness. (W.D.M.)

7602 AECU-3888
Westinghouse Electric Corp. Research Labs., East Pittsburgh, Penna.
ULTRAHIGH VACUUM TECHNIQUES. Progress Report. Research Report 100FF1054-R1. D. Alpert, J. H. Carmichael, W. J. Lange, and E. A. Trendelenburg. Dec. 31, 1956. 35p. Contract AT-11-1-gen-14. $6.30(ph), $3.00(mf) OTS.

A program has been in progress since the spring of 1956 to perform unclassified development work in the field of ultra-high vacuum techniques in connection with the "Sherwood" program. The program was set up to include: (1) the development of ultrahigh vacuum components and pumping systems, (2) a research investigation aimed at the understanding and control of factors which limit the production of high vacua, and (3) a study of the relative effectiveness of alternate methods of production of ultra-high vacuum. Progress made in these studies is summarized. (For preceding period see AECU-3630.) (A.C.)

7603 AERE-T/R-2668
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THE INSTABILITIES OF A CYLINDRICAL GAS DISCHARGE WITH FIELD PENETRATION. J. Hubbard. Nov. 1958. 36p.

Previous work has shown that a hydromagnetic model of the cylindrical gas discharge which neglects viscosity and finite electrical conductivity always predicts that the discharge will be unstable with finite field penetration when the internal and external axial fields are in the same direction. This is probably no longer so when finite viscosity and conductivity are introduced. A calculation of the stability with field penetration is described in which the effects of finite conductivity and viscosity are approximately taken into account. The numerical work was performed on the mercury computer, and a wide range of field configurations was investigated. (auth)

7604 CF-57-11-96
Oak Ridge National Lab., Tenn.
THE CRITICAL CURRENT IN THE CASE OF NEUTRAL AND PLASMA BREAKUP. Albert Simon. Feb. 26, 1959. 5p. Contract [W-7405-eng-26]. $1.80(ph), $1.80(mf) OTS.

An estimate of the critical current for the case of breakup by an arc has been obtained. It is shown that the same technique allows a quick estimate of the critical current in the case of no arc, using neutral and plasma breakup instead. (auth)

7605 NYO-2394
Princeton Univ., N. J. Project Matterhorn.
PLASMA OSCILLATIONS OF A LARGE NUMBER OF ELECTRON BEAMS. Publication No. 25. John Dawson. [Dec. 1958]. 9p. Contract AT(30-1)-1238. $1.80(ph), $1.80(mf) OTS.

The theory of longitudinal electron oscillations of a plasma is investigated by considering the plasma to consist of a large number of discrete electron beams with the positive ions forming a field neutralizing background. Mathematical support is presented for the conclusion that perturbation with predominant dispersion relations and mode frequency is damped slowly. These are the modes of the whole plasma, and the only ones which can be observed. (J.R.D.)

7606 NYO-2395
Princeton Univ., N. J. Project Matterhorn.
EXPERIMENTAL MEASUREMENTS IN CONTROLLED FUSION RESEARCH. Publication No. 26. Mark A. Heald. Jan. 16, 1958. 26p. Contract AT(30-1)-1238. $4.80(ph), $2.70(mf) OTS.

A general review is given of the experimental techniques used to measure the properties of high-temperature ionized gases encountered in controlled fusion research. (auth)

7607 NYO-6383
[Princeton Univ., N. J. Project Matterhorn.]
PROPOSED ELECTRICAL NETWORK ANALOGUE FOR HELICALLY INVARIANT FIELDS. Technical Memorandum No. 38. H. R. Koenig and K. E. Wakefield. May 17, 1956. 20p. Contract AT(30-1)-1238. $3.30 (ph), $2.40(mf) OTS.

The electrical network analog board discussed is to be used primarily to study methods of generating helical fields, to obtain information to be used in plasma equilibrium and stability studies, and to gain experience preparatory to building a larger board on which plasma equilibrium problems might be handled. The theory is developed, and construction and operation of the board are discussed. (W.D.M.)

7608 UCRL-5100
California. Univ., Livermore. Lawrence Radiation Lab.
GENERAL REVIEW OF THE ASTRON THERMONUCLEAR PROGRAM. N. C. Christofilos. Jan. 24, 1958. Decl. Sept. 3, 1958. 5p. Contract W-7405-eng-48. $1.80(ph), $1.80(mf) OTS.

The first objective of the program is the design and construction of a model to test the Astron concept. The basic features of this concept are described. The work to date consists mainly of design of the model and investigations in the theoretical field. (A.C.)

7609 UCRL-5104
California. Univ., Livermore. Lawrence Radiation Lab.

INJECTION OF ELECTRONS INTO THE ASTRON REACTOR. N. C. Christofilos. Jan. 27, 1958. Decl. Sept. 3, 1958. 7p. Contract W-7405-eng-48. $1.80(ph), $1.80(mf) OTS.

The injection of the E-layer electrons into the Astron reactor is described by following the electrons as they emerge from the anode of the 1-Mev electron gun through the various steps up to their injection in the reactor volume. Several problems are imposed by this injection process and their solutions are discussed briefly. The detailed mathematical theory and calculations will be presented in a separate paper. (auth)

7610 UCRL-5400

California. Univ., Livermore. Lawrence Radiation Lab.

MICROWAVE INTERFEROMETER MEASUREMENTS FOR THE DETERMINATION OF PLASMA DENSITY PROFILES IN CONTROLLED FUSION EXPERIMENTS. Charles B. Wharton and Donald M. Slager. Nov. 6, 1958. 8p. $1.80(ph), $1.80(mf) OTS.

A method for determining the spatial distribution in density of a plasma has been outlined in a previous paper. The method involves measuring the dispersive microwave propagation coefficients simultaneously at several frequencies and comparing the measured values with the values calculated for various distribution functions. Experimental verification of the method is demonstrated, and the procedure used to determine the distribution function in a sample laboratory plasma experiment is described. (auth)

7611 CEA-tr-R-486

QUELQUES TRAVAUX DE L'INSTITUT DE L'ENERGIE ATOMIQUE DE L'ACADEMIE DES SCIENCES DE L'URSS SUR LES REACTIONS THERMONUCLEAIRES CONTROLEES. (Some Works of the Institute of Atomic Energy of the Academy of Sciences of the U.S.S.R. on Controlled Thermonuclear Reactions.) I. V. Kourchatov. Translated into French by B. Vinogradov from Rapport Moscou 1958. 17p.

The work done at the Institute of Atomic Energy on the adiabatic trap method of obtaining stabilized thermonuclear reactions is briefly reviewed, and the design and construction of OGRA are described. (J.S.R.)

7612

INTRODUCTION TO THE THEORY OF A THERMONUCLEAR REACTOR. T. Daino, G. Gandusio, and S. Polezzo (ENI Laboratori di Ricerca Scientifico-Tecnica, Milan). Energia nucleare (Milan) 5, 795-814 (1958) Dec. (In Italian)

After a review of the various phenomena appearing in a gas through which an electric warming current is made to pass, conditions are fixed so that the gas, completely ionized, can be confined in a stable manner. The inherent stability criteria of a possible fusion reactor are indicated, assuming that every problem concerning high temperatures and plasma confinement has been solved. 29 references. (auth)

7613

AXIAL POSITIVE ION VELOCITIES IN SCEPTRE III. T. P. Hughes and S. Kaufman (Associated Electrical Industries Ltd., Aldermaston, Eng.). Nature 183, 7-8 (1959) Jan. 3.

Recent investigations indicate that highly ionized atoms in the high-current discharges in Zeta and Sceptre show marked Doppler broadening. It has yet to be shown conclusively that the ion motion involved is due to a high ion temperature. If this is the case, one of the conditions which should be satisfied is that the broadening should be independent of the direction from which the discharge is viewed. In previous work, the discharge was viewed only in the radial direction, that is, perpendicularly to the gas current. Observations are reported of the broadening in the directions parallel to, as well as perpendicular to, the gas current. Also, measurements were made of ion drift velocities. Preliminary observations indicate that the magnitude of the Doppler widths is independent of the line of sight and that some impurity ions possess axial velocities of about (1 to 2) $\times 10^6$ cm sec^{-1} in the direction of positive ion current. (J.H.M.)

7614

THE POSITIVE ION HEATING MECHANISM IN SCEPTRE III. A. A. Ware (Associated Electrical Industries Ltd., Aldermaston, Eng.). Nature 183, 8-10(1959) Jan. 3.

A simple model has been taken for the discharge in Sceptre III, and on this basis it has been deduced that the deuterons should have a mean velocity somewhat greater than that observed for the OV ions. The appreciable gas momentum involved is consistent with the electrons losing to the walls a small percentage of the momentum they receive from the electric field. The discrepancy between the electron temperature calculated from the resistivity of the gas and that measured spectroscopically suggests that impurity ions may play a major part in scattering the deuterons. If this is so, the deuterons will retain most of the energy they receive from the electric field, and positive ion temperatures of the order of magnitude indicated by Doppler broadening for OV are to be expected. The theory thus shows that there is a simple and consistent explanation of the Doppler broadening on the basis that thermal motion is the cause. Because of the simplifying assumptions which have been made, however, the theory cannot be regarded as a proof of the existence of such temperatures. (auth)

7615

POSSIBILITY OF ION RUNAWAY IN ZETA. A. Gibson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature 183, 101-2(1959) Jan. 10.

Investigations indicate that runaway ions cannot occur in the conditions which apply on the average in Zeta. It is possible that ion "runaway" occurs in restricted regions of the discharge where conditions are abnormal. Examples of such regions are: regions where the electron velocity is limited by other means than collisions with the deuterons; regions of low electron temperature into which particles may be injected, from other parts of the plasma, with sufficient energy to satisfy the relationship $W_i/W_e > 1.6$ (where W_i is the velocity of a singly charged ion and W_e is the mean thermal velocity of the electrons); and regions largely occupied by runaway electron streams, where ion–electron collisions are unimportant. There is as yet insufficient evidence to show whether or not any such regions exist. (J.H.M.)

7616

A NON-THERMAL DIRECT-CURRENT PLASMA-HEATING MECHANISM. Daryl Reagan (Engineering Lab., Oxford). Nature 183, 102(1959) Jan. 10.

It has been suggested that the power required to heat a plasma to thermonuclear temperature may be greatly reduced by applying the ion relaxation principle. In this scheme, an oscillation in a magnetic field at a frequency

much lower than the frequency of electron collision heats the ions quickly, without appreciably heating the electrons. Since, in a plasma at equilibrium, the electrons are responsible for nearly all the loss of heat, this is a great advantage. In this investigation it is shown that, under the influence of an axial unidirectional electric field (as in Zeta and Sceptre), the orbits of electrons in a plasma are distorted in such a way that they feed power to travelling compression waves in the plasma. It is conceivable that, by this means and with a suitable choice of parameters, a substantial fraction of the total power available to ring discharge might be converted to ion energy. (J.H.M.)

7617

MICROWAVE EMISSION FROM HIGH-TEMPERATURE PLASMAS. David B. Beard (Univ. of California, Davis and Lockheed Aircraft Corp., Palo Alto, Calif.). Phys. Rev. Letters 2, 81-2(1959) Feb. 1.

Recent investigations have suggested alarmingly high energy losses from plasmas contemplated in fusion research due to cyclotron radiation. A calculation is made in which it is concluded that the loss is definitely negligible for plasma temperatures less than and most probably greater than 100 kev. The calculation was carried out explicitly for a spatially varying magnetic field characteristic of mirror machines. (W.D.M.)

7618

FAST ION HEATING. Daryl Reagan (Engineering Lab., Oxford). Phys. Rev. Letters 2, 82-3(1959) Feb. 1.

The remarkably fast ion heating observed in high-current stabilized gas discharges may be due partly to an ion relaxation process described by Schluter. To get an idea of how fast the compression mode energy can be given to the ions, Schluter's expression for the ion temperature e-folding time is used. In Zeta, for ion temperatures of 1, 10, and 100 ev, e-folding time values of 0.05, 0.005, and 0.1 msec were obtained. Corresponding values in Sceptre were 0.3, 0.01, and 0.01 msec. (W.D.M.)

7619

SPONTANEOUSLY GROWING TRANSVERSE WAVES IN A PLASMA DUE TO AN ANISOTROPIC VELOCITY DISTRIBUTION. Erich S. Weibel (Space Technology Lab., Inc., Los Angeles). Phys. Rev. Letters 2, 83-4 (1959) Feb. 1.

Self-excited transverse electromagnetic waves which involve only the electrons were found to exist in plasmas provided the velocity distribution is sufficiently anisotropic. Their existence and rate of growth are derived from the Boltzmann transport equation, neglecting the collision term and retaining only linear terms of the perturbation. (W.D.M.)

7620

INVESTIGATIONS OF CONTROLLED THERMONUCLEAR REACTIONS IN USSR. L. A. Artsimovich. Uspekhi Fiz. Nauk 66, 545-69(1958) Dec. (In Russian)

Approaches to controlled thermonuclear reactions being developed in USSR are reviewed. Pulse processes of slow duration, pulse discharges with slow current increase in toroidal chambers, and magnetic pinch are discussed. The designs of the installations are presented. (R.V.J.)

7621

THE PLASMA IN A MAGNETIC FIELD. A Symposium on Magnetohydrodynamics. Rolf K. M. Landshoff, ed. Stanford, Calif., Stanford University Press, 1958. 136p.

Ten papers were presented on kinetic theory, confinement and instabilities of a plasma, and high-speed fluid dynamics. For large values of the temperature, electrons and ions travel quite long distances before cumulative effect of collisions becomes appreciable. Some configurations of importance which are discussed can be studied best through an individual orbit analysis. Magnetic field-plasma interface instabilities are discussed from both pinch effect studies and astrophysical observations. It is shown how high-speed flow can be generated as well as modified by magnetic forces. (W.D.M.)

CRITICALITY STUDIES

7622 HW-53618

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

NUCLEAR CRITICALITY IN HANDLING AND PROCESSING PLUTONIUM. Norman Ketzlach. Nov. 14, 1957. Decl. Jan. 13, 1959. 21p. Contract W-31-109-Eng-52. $4.80(ph), $2.70(mf) OTS.

Some of the nuclear safety considerations in the handling and processing of plutonium solutions as well as slurries of plutonium oxides in water whose bulk density is less than about 3.5 grams plutonium per cubic centimeter are presented. The dissolution of plutonium metal is mentioned briefly to illustrate some of the effects of surrounding metal by a solution of the same material. Criticality conditions for plutonium–aluminum alloys are not discussed at this time. (auth)

7623 NAA-SR-3096

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

EXPONENTIAL EXPERIMENTS WITH GRAPHITE LATTICES CONTAINING MULTIROD SLIGHTLY ENRICHED URANIUM FUEL CLUSTERS. W. W. Brown, F. L. Fillmore, and B. L. Scott. Jan. 15, 1959. 46p. Contract AT-11-1-GEN-8. $1.25(OTS).

Studies of 13 exponential experiments with graphite moderated lattices containing multirod fuel clusters are presented. The bucklings and detailed intracell flux distributions were measured for each lattice. Average flux values for each material of the unit cell are given. The theoretical analysis yields a value of the effective resonance integral and of the resonance neutron inverse diffusion length in the moderator, which can be used in 2-group sodium graphite reactor calculations. There is evidence that neutron spectral hardening corrections are important, but a crude treatment of this effect did not improve the fit to the experimental measurements. The calculations are presented in detail, and various lattice parameters are tabulated. (auth)

7624 UCRL-5349

California. Univ., Livermore. Lawrence Radiation Lab.

CRITICAL PARAMETERS OF SPHERICAL SYSTEMS OF ALPHA-PHASE PLUTONIUM REFLECTED BY BERYLLIUM. H. Robert Ralston. Sept. 10, 1958. Decl. Jan. 7, 1959. 9p. Contract W-7405-eng-48. $0.50(OTS).

The critical thicknesses of Be reflectors for α-phase Pu spheres of 2.472, 3.217, 3.933, 4.664, and 5.426 kg were found to be 32.0 ± 4.0, 21.0 ± 1.0, 13.0 ± 0.1, 8.17 ± 0.03, and 5.22 ± 0.02 cm, respectively, for Be density of 1.84 g/cc and Pu average density 19.25 g/cc.

A description of measuring techniques and apparatus is given. (T.R.H.)

GEOLOGY AND MINERALOGY

7625 NYO-7908

Pennsylvania State Univ., University Park. Coll. of Mineral Industries.

AN INVESTIGATION OF THE MINERALOGY AND PETROGRAPHY OF URANIUM-BEARING SHALES. Consists of thesis: AN INVESTIGATION OF THE RELATIONSHIPS BETWEEN SELECTED MINERALS, TRACE ELEMENTS AND ORGANIC CONSTITUENTS OF SEVERAL BLACK SHALES. Erwin O. Strahl. July 14, 1958. 169p. Contract AT(30-1)-1202. $3.00(OTS).

The relationships among the mineral, organic, and trace element constituents of samples of the Chattanooga and the Ohio shales in the United States, the St. Hippolyte of France, and the Alum shale of Sweden were investigated and discussed in terms of the geochemical environments. The relative importance of the environmental factors was evaluated. A total of 280 samples was analyzed for total carbon, organic carbon, aliphatic and aromatic hydrocarbon, carbonate, total iron, iron oxides, pyrite, total silicates, quartz, kaolinite, illite, amorphous silicates, uranium, molybdenum, manganese, and quartz grain size. The methods for the analysis of the hydrocarbons, the silicate minerals and molybdenum and manganese were developed or improved in order that suitable quantitative data could be obtained. The amounts of aromatic and aliphatic hydrocarbons obtainable from a shale by CS_2 extraction were determined by nuclear magnetic resonance spectroscopy. The amounts of quartz, kaolinite, illite, and amorphous silicates were determined by first roasting and acid leaching the samples and then obtaining x-ray diffractometer tracings. The molybdenum and manganese were quantitatively determined by using a method which combined the advantages of solution–spark and mutual standard emission spectroscopy. The data obtained were analyzed using correlation and factor analysis. It is concluded that the compositions of the shales investigated are highly dependent on the geological factors of environment. The redox potential; the nature of the basin of deposition, marine or continental; and the rate of deposition apparently control the mineralogical and chemical compositions of the black shales. The nature of the organic material, bituminous or carbonaceous, appears to be related to both the type of material available and to the oxidation of the sediment during deposition. These geological factors are interrelated and the composition of a shale is the result of the joint action of these factors during deposition. (auth)

7626 RME-1072(Rev.)

Division of Raw Materials. Denver Branch Office, AEC.

AIRBORNE RADIOMETRIC RECONNAISSANCE IN THE WIND RIVER BASIN, WYOMING, 1954. Tom H. W. Loomis and Robert G. Blair. June 1957. 34p., 1 illus. $1.00(OTS).

A program of airborne radiometric reconnaissance for uranium was conducted in eastern Fremont and western Natrona Counties, in central Wyoming. Rocks ranging in age from Precambrian to Quaternary were surveyed for radioactivity. The upper part of the Wind River formation of Eocene age was found to be the most favorable for uranium deposits. Uranium minerals found at the anomalies included metaautunite, autunite, phosphuranylite, uraniferous opal, torbernite, uraniferous carbonate-fluorapatite, uraniferous asphaltite, uranophane, dewindtite, and renardite. Over 350 flying hours were logged. A total of 204 anomalies was reported by the aircrew. Drilling on two of these anomalies discovered ore which is being mined. Surface features which may indicate other ore bodies warrant further investigations. (auth)

7627 TEM-205

Geological Survey, Washington, D. C.

BASE MAPS OF A PART OF THE THOMPSONS DISTRICT, GRAND COUNTY, UTAH. R. P. Fischer, J. MacKallor, and C. N. Brown, comps. Feb. 1952. 3p., 4 illus. $6.30(ph OTS); $3.00(mf OTS).

Many carnotite deposits are being mined in the Thompsons district a few miles south and southeast of Thompsons, Grand County, Utah. The district is being explored with diamond drilling and is being studied geologically. In connection with this work, base maps, comprising four sheets, have been prepared for about 10 square miles in the central part of the district. These maps show roads, land lines, topography, and drainage. They were prepared by plane-table methods, are at the scale of 1 in. equals 500 ft, and are reasonably accurate, but they do not comply with National Map Accuracy Standards. Map datum and coordinates are assumed. (auth)

7628

CONTRIBUTION TO THE GEOCHEMISTRY OF EUROPIUM. Massimo Fenoglio and Germano Rigault. Atti acad. Nazl. Lincei Rend. Classe sci. fis. mat. e nat. 22, 420-9(1957) Apr. (In Italian)

From 74 mineral samples studied spectrographically, in six the presence of europium was detected. There were two each from Italy, Germany, and Great Britain. Possible mechanisms for the distribution and diffusion of europium are discussed. (J.S.R.)

7629

URANIUM DEPOSITS IN SEDIMENTARY FORMATIONS IN FRANCE AND IN THE FRENCH UNION. I. F. Kervella. Bull. inform. sci. et tech. (Paris) No. 16, 2-8 (1958) Apr. (In French)

In this study the actual state of knowledge concerning the uranium deposits in sedimentary rocks of France and the French Union is discussed. The first part of the study considers the radioactive deposits found in southeast Gabon in French Equatorial Africa. The mineralization appears in a sandstone complex in an area strongly affected by tectonic phenomena. The first work done at Mounana has shown a mineralization of the uranium–vanadium type where the yellow essential product of the oxidation area is a hydrated uranium vanadate containing lead. This is a new mineral and was named Francevillite. (J.S.R.)

7630

URANIUM DEPOSITS IN SEDIMENTARY FORMATIONS IN FRANCE AND THE FRENCH UNION. II. F. Kervella. Bull. inform. sci. et tech. (Paris) No. 17, 11-28(1958) May. (In French)

The French deposits found in Cambrian and Carboniferous rocks are studied. In the lower Paleozoic, where marine facies are dominant, uranium occurrences are seldom found. Nevertheless, some interesting occurrences have been found in the Georgian of Vigan area, but due to their extension and uranium contents their

extraction does not seem to be of economic interest. In the carboniferous rocks, lacustrian or continental facies are prevailing. Many occurrences are actually known (Graissessac and Blanzy basins, La Chapelle-sous-Dun, Basin of Basse-Loire and specially those of Ronchamp and Saint-Hippolyte). In the Ronchamp Basin (Haute-Saône), the mineralization is contained in schists and coal-bearing sandstones of middle Stephanian and extends in the "talcous" series of the lower Stephanian. The mineralization is sometimes rich but discontinuous. As it is located below 800 m, in a deserted mine, ore-extraction cannot be contemplated. This is not the case at Saint-Hippolyte (Haut-Rhin) where uranium is contained in lacustrian schists of Westphalian or lower Stephanian rocks (Schaentzel, Teufelsloch, Warich, Thannenkirch). These basins which have been studied by drilling and mining, have shown good ore-reserves. The ore has either a rather high uranium content (Teufelsloch, Thannenkirch), or a lower content, but with good mining conditions (Schaentzel, Warik). Uranium does not exist in a mineralogically defined form, but in form of "carburanes," complexes bound to organic matter, accompanied by mispickel, pyrite, galena and blende. (auth)

7631

URANIUM DEPOSITS IN SEDIMENTARY FORMATIONS IN FRANCE AND THE FRENCH UNION. III. F. Kervella. Bull. inform. sci. et tech. (Paris) No. 18, 22-30 (1958) June. (In French)

The uranium deposits contained in sedimentary formations of Permo-Trias are surveyed. Permian and Triassic uranium deposits are known in the Vanoise Alps (Champagny area). Maritime Alphs (Liouc, Tinée Valley, Vesubie Valley, and Esterel deposits), and Herault, where important occurrences were recently found not far from Lodève. Other occurrences, of various importances, are known in Correze, in the Vosges mountains, in the Blanzy Basin. (auth)

7632

URANIUM DEPOSITS IN SEDIMENTARY FORMATIONS IN FRANCE AND THE FRENCH UNION. IV. F. Kervella. Bull. inform. sci. et tech. (Paris) No. 19, 16-31 (1958) July. (In French)

The deposits found in the cretaceous, tertiary, and quaternary sedimentary formations are studied. The cretaceous and tertiary formations contain large uranium deposits, among which the phosphate deposits of Morocco constitute huge potential reserves of uranium. Uraniferous phosphate deposits are also found in Senegal (Thiès), Togo (Akoumapé) and Middle Congo (Holle). Two sedimentary deposits, both probably connected with oligocene formations, exist in France: one, in the Ambert area (Puy-de-Dôme), the other, much more promising, at Saint Pierre (Cantal). In the quaternary series the deposits are essentially those of Vinaninkarena (Madagascar), which are of lacustrian origin. (auth)

7633

THE RADON CONTENT OF COLD WATERS OF SOME REGIONS OF FRANCE. Marcel Roubault, René Coppens, and Georges Jurain. Compt. rend. 248, 715-17 (1959) Feb. 2. (In French)

The radon content of 344 cold waters of different regions of France was measured using an automobile laboratory. The very high percentages found were over the usually accepted tolerance dose. (tr-auth)

7634

SOME NATURAL VARIATIONS IN THE RELATIVE ABUNDANCE OF COPPER ISOTOPES. E. C. Walker, F. Cuttitta, and F. E. Senftle (U. S. Geological Survey, Washington). Geochim. et Cosmochim. Acta 15, 183-94 (1958).

The relative isotopic abundance of copper has been measured in a number of minerals and a few plant materials. Suites of samples from Michigan and the Colorado Plateau have been examined in more detail to determine if local variations due to isotopic exchange or diffusion could be found. The relative isotopic abundance of copper in specimens from several other localities was also determined. The variations noted were small but in some cases were felt to be significant because they were larger than the experimental error (0.1 per cent in the ratio). A total spread of −1 to +8 parts per mil compared to the standard was found in the specimens tested. (auth)

7635

THE DEUTERIUM CONTENT OF WATER IN SOME VOLCANIC GLASSES. Irving Friedman and Robert L. Smith (U. S. Geological Survey, Washington). Geochim. et Cosmochim. Acta 15, 218-28(1958).

The deuterium–hydrogen composition (relative to Lake Michigan water = 0.0) of water extracted from coexisting perlite and obsidian from eleven different localities was determined. The water content of the obsidians is generally from 0.09 to 0.29 per cent by weight, though two samples from near Olancha, California, contain about 0.92 per cent. The relative deuterium concentration is from −4.6 to −12.3 per cent. The coexisting perlite contains from 2.0 to 3.8 per cent of water with a relative deuterium concentration of −3.1 to −16.6 per cent. The deuterium concentration in the perlites is not related to that in the enclosed obsidian. The deuterium concentration in the perlite water is related to the deuterium concentration of the modern meteoric water and the perlite water contains approximately 4 per cent less deuterium than does the groundwater of the area in which the perlites occur. The above relations hold true for perlites from northern New Mexico, east slope of the Sierra Nevada, California Coast Range, Yellowstone Park, Wyoming, and New Zealand. As the water in the obsidian is unrelated to meteoric water, but the enclosing perlite water is related, we believe that this is evidence for the secondary hydration of obsidian to form high water content perlitic glass. (auth)

7636

NIOBIUM–ZIRCONIUM–THORIUM–URANIUM AND RARE-EARTH MINERALS FROM THE PEGMATITES OF SOUTH HARRIS, OUTER HEBRIDES. O. von Knorring and R. Dearnley (The University, Leeds, Eng.). Nature 183, 255-6(1959) Jan. 24.

Information is presented on mineral occurrences in the Chiapaval and Roneval pegmatites of South Harris, Scotland. The Chiapaval pegmatite vein consists of microcline, albite, and quartz, with a subordinate amount of muscovite as the major mica constituent. Of the minor minerals, topaz, beryl, block-tourmaline, and garnet have been found; the latter mineral seems to be quite abundant locally and was found to contain some 20 per cent of manganese monoxide. In addition, the following minerals have been found: columbite; thorite; uraninite; kasolite; a mineral with an x-ray diffraction pattern almost identical with kasolite, but predominantly

a thorium–lead silicate; betafite; zircon; monazite; allanite; and gahnite. The Sletteval pegmatite quarries, east of Roneval, were examined; but apart from apatite no unusual minerals were observed. A pegmatite northeast of Sletteval contained numerous magnetite aggregates which were found to be quite radioactive. Laboratory investigation showed that this pegmatite contained uraninite, thorite, monazite, uranophane, and epidote, together with metamict zircon and allanite, and minor spessartine and pyrites. (J.H.M.)

7637

PROSPECTING FOR URANIUM ORES IN POLAND. J. Burek (Geological Inst., Warsaw). Nukleonika 3, 547-60(1958). (In Polish)

The occurrence of uranium and the problem of prospecting for uranium ores in Poland are discussed. The radiometric survey methods hitherto used have given good results, and a number of ore deposits lying near or protruding from the earth's surface have been found. These methods cannot give results in the case of "blind ore deposits"; in this case geochemical and geophysical (geoelectric) methods are recommended. (tr-auth)

7638

ON THE GEOCHEMISTRY OF URANIUM AND ON THE URANIUM NATURAL CONCENTRATIONS. Antoni Polański (Warsaw Univ. of Applied Chemistry). Nukleonika 3, 647-60(1958). (In Polish)

The main features of uranium geochemistry in igneous rocks, pegmatites, hydrothermal and sedimentary rocks are reported. Special attention was drawn to the conditions of natural uranium concentrations in the form of deposits. The main types of the U deposits are discussed. (tr-auth)

7639

METAMORPHISM OF URANIUM ORES. V. S. Karpenko. Soviet J. Atomic Energy (English Translation) Suppl. No. 6, Geology of Uranium, 1-13(1958).

The metamorphic reconstitution of ores in a deposit of primary sedimentary accumulations is described. The uranium mineralization was confined to layers of highly metamorphosed sedimentary rocks of upper Paleozoic age and was in the proximity of zones of upper Cretaceous granitic intrusions. Indications of premineralization "ore-control" structures were absent, except for the marked attraction of ore concentration to small anticlinal uplifts which occur in parts of the deposit. The ore bodies are in a bedded form and are restricted to a single stratigraphic horizon, the roof rock of a diabase sill. The mineralization is localized in beds of medium-grained sandstones and is completely absent from phyllites and silty sandstones. There is no relationship between mineralization and the chemical and mineral composition of the host rock. The uraninite in the sandstone cement has a hydrothermal-metasomatic nature. The metamorphic transformations in the bedded ores during later separation from the uraninite of such metamorphic minerals as diopside, albite, and others are clearly indicated. The uraninites of all bedded ores have common geochemical features, but the uraninite in vein-like bodies is distinctive. Near-ore alteration of the host rocks is absent, and there is insignificant introduction of elements during metamorphism. A hydrothermal-metamorphic origin of the ore concentration is assumed for a simple and logical explanation of these features. (J.S.R.)

7640

THE NATURE OF SEDIMENTARY-METAMORPHIC URANIUM MINERALIZATION. R. V. Getseva. Soviet J. Atomic Energy (English Translation) Suppl. No. 6, Geology of Uranium, 14-28(1958).

The lithological and mineralogical features of uranium ores in comparatively weakly metamorphosed lower Paleozoic rocks are presented. These clearly indicate a possibility of uranium concentration during regional metamorphism of sedimentary beds in a geosynclinal zone. (J.S.R.)

7641

THE ORIGIN OF URANIUM MINERALIZATION IN COAL. Z. A. Nekrasova. Soviet J. Atomic Energy (English Translation) Suppl. No. 6, Geology of Uranium, 29-42(1958).

The geology and uranium mineralization of a typical Jurassic coal-bearing deposit are discussed as a basis for the examination of the problem of the origin of such uranium mineralizations. The common features of uranium–coal deposits are reviewed. It is concluded that the origin of these deposits is epigenetic. The criteria to be used for prospecting for uranium in coal deposits are listed. (J.S.R.)

7642

NEW DATA ON NENADKEVITE. V. A. Polikarpova. Soviet J. Atomic Energy (English Translation) Suppl. No. 6, Geology of Uranium, 43-55(1958).

Data are presented on the systematic composition and conditions of formation of nenadkevite. The paragenesis of the mineral and the distinctive features of its chemistry point to a hypogene origin. The nenadkevite was formed in the culminating phase of high-temperature pneumatolytic-hydrothermal stage of sodium metasomatism in the intergranular interstices. The mineral formed primarily as a hydrosilicate, predominantly of quadrivalent uranium, rare-earth elements, calcium, and magnesium. The general formula of the group is $(U^{4+}Y,Ce,Th)U^{6+}$ (CaMgPb) $[SiO_4]_2[OH]_4 \cdot nH_2O$. There are no analogs of this mineral, but in its various properties it stands nearest to the thorite group. (J.S.R.)

7643

THE HYDROUS URANYL AND AMMONIUM PHOSPHATE (URAMPHITE) – $NH_4(UO_2)[PO_4] \cdot 3H_2O$. Z. A. Nekrasova. Soviet J. Atomic Energy (English Translation) Suppl. No. 6, Geology of Uranium, 56-60(1958).

A natural hydrous uranyl and ammonium phosphate (uramphite) was discovered in the oxidized zone of a Russian uranium–coal deposit. Its physical and chemical properties are discussed and compared with those of a synthetic uranyl and ammonium phosphate. This comparison and the chemical analysis indicate that the formula for the mineral is $NH_4(UO_2)[PO_4] \cdot 3H_2O$. (J.S.R.)

7644

URSILITE–A NEW SILICATE OF URANIUM. A. A. Chernikov, O. V. Krumetskaya, and V. D. Sidel'nikova. Soviet J. Atomic Energy (English Translation) Suppl. No. 6, Geology of Uranium, 61-5(1958).

A distinctive silicate of uranium was found along joints in quartz porphyries. The optical properties and chemical composition of ursilite are presented. A calcium ursilite and a magnesium ursilite were identified. The interplanar distances are tabulated. (J.S.R.)

7645

CONDITIONS OF FORMATION OF NATROAUTUNITE. A. A. Chernikov. Soviet J. Atomic Energy (English

Translation) Suppl. No. 6, Geology of Uranium, 66-9 (1958).

Natroautunite was found in a fault zone cutting granodiorite. At depths of 2 to 3 meters large quantities of natroautunite appear, together with schoepite and paraschoepite. The natroautunite is less abundant than the schoepite in the upper part of the interval. At depths below 3 m, it is the only mineral found, forming local 3 to 5 mm thick patches in association with kaolinite. The lower boundary of the natroautunite was not identified. An analysis of the ground water in the fault zone showed that sodium was more abundant than calcium. Therefore natroautunite is formed instead of autunite. (J.S.R.)

7646

HYDROTHERMAL SYNTHESIS OF URANINITE. G. P. Sidorov and R. P. Rafal'skii. Soviet J. Atomic Energy (English Translation) Suppl. No. 6, Geology of Uranium, 70-3(1958).

Uraninite crystals were synthesized on slices of carbonaceous-siliceous shale by placing the shale in a quartz flask and introducing a uranyl sulfate solution with a concentration of 1 g/l. The residual air was evacuated, and the flask was placed in an autoclave and heated for 2 to 3 days at 300°C. Cooling was produced by plunging the autoclave into cold water. The properties of the uraninite crystals corresponded with those of a natural uraninite. (J.S.R.)

7647

THERMAL INVESTIGATIONS OF SOME URANIUM MINERALS. Ts. L. Ambartsumian. Soviet J. Atomic Energy (English Translation) Suppl. No. 6, Geology of Uranium, 74-102(1958).

A study was made of the physicochemical properties of schroeckingerite, uranopilite, autunite, metatorbenite, uranocircite, bassettite, zeunerite, tyuyamunite, and β-uranotile. The standard thermal curves and dehydration curves were obtained. The results of optical, x-ray, fluorescent, and chemical analyses are also included. (J.S.R.)

7648

THE RADIOMETRIC METHOD OF DETERMINING URANIUM CONTENT IN ORE SAMPLES. V. L. Shashkin and I. P. Shumilin. Soviet J. Atomic Energy (English Translation) Suppl. No. 6, Geology of Uranium, 103-10(1958).

The development of the β-γ method for the determination of the uranium content of ore samples is discussed. The theory of the method and the apparatus and procedure are reviewed. Results obtained with the β-γ method are tabulated and compared with chemical analysis. The results obtained with ore samples containing large quantities of thorium are also presented. (J.S.R.)

7649

THE RATIO OF β- AND γ-RADIATION IN NATURAL RADIOACTIVE ELEMENTS. V. L. Shashkin, I. P. Shumilin, and M. I. Prutkina. Soviet J. Atomic Energy (English Translation) Suppl. No. 6, Geology of Uranium, 111-16(1958).

The experimental data on the ratios of β and γ radiations of natural radioactive elements obtained with various types of Soviet counters are presented. (J.S.R.)

7650

METHODS AND TECHNIQUES OF AEROGEOPHYSICAL PROSPECTING FOR URANIUM DEPOSITS IN FOREIGN COUNTRIES. Ya. G. Ter-Oganesov, T. I. Gvaima, et al. Soviet J. Atomic Energy (English Translation) Suppl. No. 6, Geology of Uranium, 119-28(1958).

A survey is made of the technique and methods of aeroradiometric investigations conducted in the U.S.A., Canada, and Australia. The form and scale of aerogeophysical surveying, grid pattern and height of flight, control between observation and ground location, transporting medium, apparatus, introduction of corrections in radiometer readings, interpretation of results of aerial surveys, ground checking, and the cost of aerial prospecting are considered. 48 references. (J.S.R.)

7651

AGE HARDENING OF ALUMINIUM–ZINC ALLOYS. Helmut Maacks. Thesis, University of Berlin, 1958. (In German)

The age hardening phenomena of Al–Zn alloys were investigated as functions of various factors. Among the factors considered were cooling temperature, cooling speed, purity, storage temperature, heat shock at 200°C between cooling and storage, restoration heating, and cold working. The measurement of the electric conductivity was used as the investigation method. Hardness, structural, and x-ray fine structure studies supplemented the conductivity measurements. (J.S.R.)

HEALTH AND SAFETY

7652 AERE-HP/R-2607

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

PHYSICAL MEASUREMENTS OF ACTIVITY IN SAMPLES FROM WINDSCALE. D. V. Booker. Oct. 1958. 38p. $0.77(BIS).

Gamma scintillation spectrometer measurements in samples of milk, herbage, and soil from the Windscale area are described. The geographical distribution of activity is studied, and the relative activities of I-131, Cs-137, and Sr-89 are discussed. A correlation between I-131 in herbage and milk is recorded, and an estimate of the total deposition of I-131 on herbage is made. (auth)

7653 AERE-HP/R-2790

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE DEPOSITION OF LONG-LIVED FISSION PRODUCTS FROM NUCLEAR TEST EXPLOSIONS. Results up to the Middle of 1958. N. G. Stewart, R. G. D. Osmond, R. N. Crooks, E. M. R. Fisher, and M. J. Owers. Jan. 1959. 15p. $0.35(BIS).

Rain water has been collected systematically from 20 places in various latitudes and analysed for Sr^{89}, Sr^{90}, and Cs^{137} produced by nuclear test explosions. A few snow samples from polar regions have also been included. The present report extends the results already published to cover the period up to mid-1958. The total deposition at a typical station in the U.K. during the 12 months ending April 1958 was 2.6 mc/km^2 compared with 2.55 mc/km^2 in the preceding 12 months. More extensive evidence has been obtained that in the limited area of the U.K. the total deposition over a period appears to be proportional to the local rainfall. The rate of deposition in the U.K. during the four months of May

to August 1958 was considerably greater than that during the corresponding period in previous years. It is thought that part of this increase is due to the rainfall which was some 1.7 times that during the corresponding period in the three previous years. The measurements continue to support the observations in the earlier report regarding the dependence of fall-out on latitude and the marked seasonal variation. (auth)

7654 CEX-58.1

Oak Ridge National Lab., Tenn. and Division of Biology and Medicine, AEC.

EXPERIMENTAL EVALUATION OF THE RADIATION PROTECTION AFFORDED BY RESIDENTIAL STRUCTURES AGAINST DISTRIBUTED SOURCES. J. A. Auxier, J. O. Buchanan, C. Eisenhauer, and H. E. Menker. Sept. 1958. 133p. $2.75(OTS).

A study was made to obtain information that could be used to evaluate the protection afforded by residences against radiation due to fallout. The sources used were Co^{60} and Cs^{137}, and the radiation dosimeters used were pocket type ionization chambers. Measurements were made for distributed sources (400 Co^{60} and 20 Cs^{137}) and for single sources located inside the structures (one each, 2-curie Co^{60} and Cs^{137}). Attenuation measurements were made for five houses of typical domestic design and construction. Several modifications were made to the houses, and the attenuation measurements were repeated. The houses, located at the Nevada Test Site, included single- and two-story houses with and without basements and with light and heavy walls. For comparison with the house data the dose-rate distribution above an extended plane source was measured in a phantom house, i.e., air measurements with the instrument fixed on a framework of thin-walled aluminum tubing. Although the complete analysis of the data is not yet available, some typical analyses are presented, and the effectiveness of some of the modifications is illustrated. (auth)

7655 ITR-1484

Federal Civil Defense Administration, [Washington, D. C.].

RADIOLOGICAL DEFENSE OPERATIONS PHOTOGRAPHY. Preliminary Report. Martin Lobdell. Aug. 1957. 42p. Project 36.3 [of] OPERATION PLUMBBOB.

The purpose of this project was to prepare a motion picture of Radiological Defense operational and training procedures encompassed in Civil Effects Test Group Program 36 for use as a visual orientation device in the Federal Civil Defense Administration Radiological Defense Training Program. Photography and sound recording at the site was based on a shooting script prepared and approved prior to production. (auth)

7656 LAMS-2117

Los Alamos Scientific Lab., N. Mex.

RADIOACTIVE DECONTAMINATION TESTS ON SURGEON'S GLOVES CONTAMINATED WITH PLUTONIUM. W. R. Kennedy and J. B. Webber. Mar. 1957. 7p. Contract W-7405-eng-36. $1.80(ph), $1.80(mf) OTS.

A technique was devised for applying plutonium activity to gloves, washing them in various decontamination solutions, and evaluating the relative effectiveness of these solutions for removing the activity. When the most efficient solution for decontamination was determined, decontamination of various lots of gloves from a laboratory handling plutonium was attempted. For a run-of-the-lab lot of gloves, 80% were decontaminated and recovered for re-use. For gloves from an extremely "hot" laboratory, recovery efficiency depended upon whether or not the lot had been cross-contaminated by one or two highly contaminated gloves. The cost of decontaminating gloves was approximately three times the cost of new gloves. While on a routine, large lot basis, this cost could be lowered considerably, it appears to be uneconomical to decontaminate gloves unless new gloves should become unavailable. "Consumer resistance" to washed gloves was found to be present among users. (auth)

7657 LAMS-2293

Los Alamos Scientific Lab., N. Mex.

NUCLEAR-CRITICAL ACCIDENT AT THE LOS ALAMOS SCIENTIFIC LABORATORY ON DECEMBER 30, 1958. H. C. Paxton, R. D. Baker, W. J. Maraman, and Roy Reider. Feb. 1959. 34p. Contract W-7405-eng-36. $0.50(OTS).

The nuclear-critical accident that occurred in the plutonium processing plant at the Los Alamos Scientific Laboratory on December 30, 1958, resulted from an unusual and complex set of circumstances. Reconstruction of the steps that preceded the accident and analysis of the materials involved give a reasonably specific picture of the conditions at the time of the radiation burst. (auth)

7658 NP-7313

Corps of Engineers.

COLLECTIVE PROTECTION AGAINST CHEMICAL, BIOLOGICAL, AND RADIOLOGICAL WARFARE AGENTS. W. P. Leber. Oct. 1, 1958. 44p. (EM-1110-345-461).

Fundamental principles and criteria are presented for use in the design of shelters to provide adequate and equal protection from chemical, biological, and radiological warfare agents in both gaseous and particulate form. Design criteria, drawings, and layouts are included for shelters, decontamination facilities, and ventilation systems. (C.H.)

7659 NRL-5208

Naval Research Lab., Washington, D. C.

SOME MEASUREMENTS OF THE RADIOACTIVITY OF THE AIR DURING 1957. L. B. Lockhart, Jr., R. A. Baus, R. L. Patterson, Jr., and I. H. Blifford, Jr. Aug. 25, 1958. 19p. (PB-151049). $1.00(OTS).

Measurements made during 1957 on the concentrations of some natural radioactive materials and of gross fission products in the atmosphere at ground level are summarized. Among the topics covered are the daily or monthly variations of the concentrations of radon, thoron, and gross fission products in the air at several sites in the Northern Hemisphere, in Brazil, and in Antarctica. In addition, several measurements have been made of the contribution of Be^{7} to the radioactivity of the atmosphere and of the relative concentrations of RaD and RaF in the air at ground level at Washington, D. C., and Yokosuka, Japan. It is found that fission-product levels in the Northern Hemisphere are roughly ten times as great as at similar latitudes in the Southern Hemisphere. However, the increase in the total radioactivity of the air is negligible when compared with the normal activity levels due to natural radon, thoron, and their descendents. (auth)

7660

RADIOACTIVE MATERIALS AND INDUSTRIAL FIRE PROTECTION. F. R. Farmer (United Kingdom Atomic Energy Authority). Atom No. 22, 9-16(1958) Aug.

Information is presented on the development of safe practices for fire protection and fire prevention where radioactive materials might be involved. Discussions are included on: hazards of radioactive materials and regulations for the application of radioactive materials, the increasing use of radioactive materials in industry, the behavior of radioactive materials exposed to high temperatures or fire, and the industrial user's obligations. (J.H.M.)

7661

PROTECTION AGAINST THE GAMMA RADIATION OF THE RADIOACTIVE FALL-OUT IN ATOMIC BOMB EXPLOSIONS. A. Rudloff. Atompraxis 4, 444-48 (1958). (In German)

The present study is based on the information which has been revealed concerning the extent of contamination in the fall-out area of a 15 megaton hydrogen bomb (Bikini test, March 1, 1954). On the basis of these data the protection afforded by bunkers and house cellars against the gamma radiation of fall-out is estimated. In addition, the optimal length of stay in shelters is calculated, i.e., the time at which the shelter and the fall-out area must be abandoned if the radiation dose is to be kept at a minimum. The results obtained point out the necessity of decontaminating traffic routes in fall-out areas. (auth)

7662

SORPTION OF Sr^{90} BY THE SOIL. N. A. Timofeeva and A. A. Titlyanova. Izvest. Akad. Nauk S.S.S.R. Ser. Biol. No. 1, 111-17(1959) Jan.-Feb. (In Russian)

Sorption of microamounts of strontium from solutions prepared of distilled water, calcium nitrate solution, and lake water as well as desorption of microamounts of strontium from soils by various concentrations of calcium nitrate were followed. Sr^{90} was shown to be sorbed by any soils through an ion exchange mechanism. The degree of strontium sorption by soils as well as of desorption from soils depends on the quantitative ratio of exchangeable cations of the absorbing complex of the soil and of the soil solution. It is suggested that strontium migration in soils is effected by ion exchange reactions (sorption-desorption). (tr-auth)

7663

HOW TO WORK SAFELY WITH RADIOISOTOPES. L. J. Cherubin (Knolls Atomic Power Lab., Schenectady, N. Y.) and W. A. McAdams (General Electric Co., Schenectady, N. Y.). Mill & Factory 5p.(1958) Nov.

Information is presented on the safe handling of radioisotopes. Discussions are included on biological effects of radiation, maximum permissible dose limits, radiation protection standards, government controls over types of radiation sources, and the economics of radiation protection. Also, the following basic elements of radiation protection are discussed: well-designed facilities and equipment for handling sources; identification of sources of radiation and control of access to radiation areas; operating procedures incorporating accepted standards of radiation protection; measurement of personnel exposure and in-plant and off-plant radiation levels; and employee education in the nature of radiation hazards and principles of control. (J.H.M.)

7664

THE PROBLEM OF RADIOLOGICAL PROTECTION ABROAD AND IN POLAND. J. Pensko. Nukleonika 3, 417-27(1958). (In Polish)

Methods of radiation protection in Poland and abroad are analyzed. Safety measures in handling radioisotopes, remote control devices, permissible doses of exposure, decontamination of instruments and laboratories, personnel protection, and storage and transportation of radioactive materials are discussed. (R.V.J.)

7665

MAXIMUM PERMISSIBLE BODY BURDEN OF STRONTIUM-90. R. Björnerstedt (Research Inst. of National Defense, Stockholm) and A. Engström (Karolinska Institutet, Stockholm). Science 129, 327-8(1959) Feb. 6.

The permissible body burden of Sr^{90} is discussed with respect to the mode of intake. It appears that the maximum permissible load may depend on the type of exposure, acute or chronic, the acute being the more serious. (auth)

7666

RADIATION HAZARDS AND PROTECTION. D. E. Barnes and Denis Taylor. London, George Newnes Limited, 1958. 185p.

Information is presented on the following topics: nature and properties of radiation; units of radiation and radioactivity; radioactivity; effects of radiation of the human system; naturally occurring radiations; the standard man; permissible doses; radiation output; measurement of radiation; fundamentals of instrumentation; building and laboratory design; shielding design; instruments for the measurement of radiation dose-rate; personal protection; instruments for measuring radiation dose; surface contamination; contamination monitors; air sampling; biological monitoring; apparatus and methods of radioassay; waste disposal; transport of radioactive material and other legal aspects; and radiation from nuclear weapons. (J.H.M.)

7667

MENTAL HEALTH ASPECTS OF THE PEACEFUL USES OF ATOMIC ENERGY. World Health Organization Technical Report Series No. 151. Geneva, World Health Organization, 1958. 58p. $0.60. Also available from: WHO Distribution and Sales Unit, Geneva. (In English, French, or Spanish)

The fact that the destructive potentialities of atomic energy have been focused upon by its use for military purposes accentuates and tends to exaggerate in human minds the picture of atomic energy as a destructive force. Mental health problems associated with the development of atomic energy are reviewed. (C.H.)

INSTRUMENTS

Refer also to abstracts 8356, 8369, 8375, 8380, 8381, 8393, 8398, 8399, 8400, 8409, 8410, 8411, 8413, and 8414.

7668 A/CONF.15/P/188

HEAVY-WATER MONITORING BY INFRA-RED SPECTROSCOPY. W. H. Stevens and J. G. Bayly (Atomic Energy of Canada Ltd., Chalk River, Ont.). 18p. (AECL-598). $0.25(AECL).

The infrared radiation absorption properties of H_2O, D_2O, and HDO have significant characteristics and differences which may be used for detection and analytical purposes. Rapid laboratory methods of analysis for both light in heavy and heavy in light water are de-

scribed using a double-beam infrared spectrophotometer. Methods for isotopic analysis of D_2O streams and D_2O vapor leaks are described. (W.D.M.)

7669 AERE-EL/R-2590

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE PHOSPHATE GLASS DOSIMETER. D. H. Peirson. May 1958. 40p. $0.84(BIS).

The phosphate glass dosimeter, based upon the phenomenon of radiophotoluminescence, has been developed as a personal monitor of high-range γ-ray dose. The dosimeter is small, cheap, rugged, and proof against severe climatic conditions. It is not self-indicating but may be read rapidly by a mains-operated reader designed as a simple fluorimeter. The dosimeter was developed to meet requirements of the armed services for a dosimeter to measure cumulative exposure to the initial and residual gamma radiations from a nuclear weapon. The design is suitable for large scale production. The dosimeter will register dose in two ranges, 0-600r and 0-6000r. The minimum detectable increment of dose is 5r. Dose is stored linearly (up to 1000r), permanently, and independently of radiation dose-rate, energy, and orientation. (auth)

7670 AERE-EL/R-2775

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

DATA RECORDING. Summary of a Conference held at AERE on October 3, 1958. R. C. M. Barnes. Dec. 1958. 17p.

This paper summarizes the proceedings of a conference which discussed data handling systems in which data from experiments are recorded in analogue or digital form on magnetic tape, analyzed in specialized instruments, and finally transferred to digital computers for the remaining stages of data processing. (auth)

7671 AERE-H/M-10

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

OPERATION AND CALIBRATION OF THE G.E.C. MERCURY VAPOUR DETECTOR. G. N. Walton. [194?]. 2p.

The instrument manufactured by the G.E.C. to detect and measure mercury and other vapors in the atmosphere operates as a photometer. Air to be examined is drawn by a fan into an iron tube, at one end of which is an ultraviolet lamp and at the opposite end a photoelectric tube sensitive to the radiation from this lamp (2537A). The response of the photoelectric tube decreases when mercury vapor is present, which scatters this particular radiation. The photoelectric tube is connected to the grid of a triode which forms one arm of a Wheatstone bridge circuit, by which the response of the tube is measured. During operation, the response of the instrument in the air to be examined is compared with the response in mercury free air. The latter may be obtained by passing the air to be examined over dry hopcalite which effectively absorbs mercury vapor. (auth)

7672 AERE-I/R-2773

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE CHOICE OF COUNTING EQUIPMENT. B. H. Parks. Dec. 1958. 34p. $0.70(BIS).

This report is intended to provide some assistance in the selection of radiation detecting and measuring equipment from that currently produced in Britain. Tables of the more commonly used types of instruments are given, summarizing the products of various manufacturers. (W.D.M.)

7673 APEX-447

General Electric Co. Missile and Ordnance Systems Dept., Burlington, Vt.

DEVELOPMENT OF A PULSE PREAMPLIFIER FOR USE AT 542°F. Interim Progress Report. W. L. Frisby. June 27, 1958. 96p. For General Electric Co. Aircraft Nuclear Propulsion Dept. Contracts AF33(600)-38062 and AT(11-1)-171. $2.25(OTS).

A broad-band linear amplifier for pulse use has been developed and given limited evaluation at chassis temperatures of 600°F for several hours without failure. Gain drift was observed to be less than 0.013%/°F including initial aging. (auth)

7674 AWRE-NR/P-12/58

United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England.

FAST NEUTRON TIME OF FLIGHT SPECTROMETER FOR THE 6 MEV VAN DE GRAAFF GENERATOR. R. Batchelor and J. H. Towley. Feb. 1959. 22p.

This apparatus has been built for measuring the spectrum of neutrons emitted either in reactions initiated by monoenergetic charged particles, or in neutron-induced processes such as inelastic neutron scattering. For neutron-induced reactions the monoenergetic primary neutron flux is produced by bombarding a light element with protons or deuterons. (auth)

7675 BNL-531

Brookhaven National Lab., Upton, N. Y.

AN IONIZATION CHAMBER LAUNDRY MONITOR. John D. Chester and John S. Handloser. June 1958. 6p. $0.50(OTS).

The determination of the amount of contamination remaining on a garment after it has been washed is an important part of hot laundry operations. In the past garments were monitored by measuring the contamination concentrated in the crotch with a GM tube probe. This type of spot check does not detect any isolated hot spots on other parts of the garment. To monitor the entire garment with a GM tube instrument is excessively time consuming for a large number of garments. To overcome these difficulties a sensitive, large-volume ionization chamber was constructed. It is rectangular in shape, 5 ft high by $2\frac{1}{2}$ ft wide by 4 in. deep. The center electrode is of a grid type and is mounted halfway between the front window and the back of the chamber. In a 0.5-mr/hr field, 180 v is sufficient to saturate the chamber. In order to insure β sensitivity, the front window has an equivalent thickness of ≈ 7 mg/cm^2. The measuring device is a line-operated electrometer circuit equipped with an alarm that may be set at the rejection limit for the type of garment being monitored. A full-scale deflection on the most sensitive range is given by 2 to 3 μC of liquid mixed fission products deposited on a garment. Since the chamber monitors the entire garment, the results are independent of the location of the contamination. In practice, garments may be monitored at the rate of 7 per min, while only 3 per min may be completely checked with a GM tube probe. Field tests indicate that this instrument is stable and trouble free.

Background causes a meter deflection of about 20 divisions, which is low enough to give reliable accuracy for monitoring garments. (auth)

7676 CF-59-1-5
Oak Ridge National Lab., Tenn.
TEST OF PK PUMP SPLIT PURGE GAS LABYRINTH. D. L. Gray. Jan. 17, 1959. 12p. Contract [W-7405-eng-26]. $3.30(ph), $2.40(mf) OTS.

A split gas purge arrangement was applied to the shaft of a centrifugal pump of the vertical shaft overhung impeller sump type. The purge was introduced to the pump shaft annulus below the lower seal and above the pump tank gas volume; a portion flowed upward into the catch basin; the remainder flowed downward into the pump tank gas volume. Vents were provided for catch basin and pump tank regions. The pump (Model PKP) was operated with NaK at 1200°F and 3000 ± 600 rpm for 3378 hours. The test was terminated when purge supply ports leading directly to the shaft annulus plugged. The split purge did succeed in keeping gross NaK vapors from the lower seal. Further modifications of the original arrangement are proposed to prevent plugging of the helium ports. (auth)

7677 HW-54264
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
DESIGN AND INSTALLATION OF A HIGH PRECISION TEMPERATURE AND INTIMATE CONTACT MONITOR FOR EXPERIMENTAL VACUUM CHUCKS. G. W. Morrow. May 15, 1958. 34p. Contract W-31-109-Eng-52. $1.00(OTS).

The design criteria, design details, and final installation of a high-precision temperature and intimate contact monitor is described. The system was designed to sense intimate contact between surfaces of the specimen and the chuck, and measure and control the temperature of a specimen of metal during machining on a lathe. (W.L.H.)

7678 LA-2244
Los Alamos Scientific Lab., N. Mex.
ELECTROMAGNETIC IMPULSE TRANSMISSION AND RECEPTION USING A WIDE BAND ANTENNA. Leland K. Neher. July 1958. 45p. Contract W-7405-eng-36. $1.25(OTS).

An interesting method for transmitting and receiving electromagnetic pulses of small time duration over a limited distance is the use of the transient response function of a wide band antenna system. Tests were conducted with one type of wide band antenna: the discone antenna. Although the method is very inefficient compared with the conventional modulated carrier wave transmission system, there does exist the possibility of measuring the time between several pulses to a high precision. Impulses of 10^7 watts peak power applied to a 2.75 meter discone antenna radiated 10^6 watt transient pulses of the order of 5×10^{-8} sec long, which were received over local areas and over 23 kilometers of sea water. A directional receiver employing separated discone antennas whose signals were mixed in a simple coincidence system is also discussed. (auth)

7679 RIB-36
DuMont (Allen B.) Labs., Inc., Clifton, N. J.
DEVELOPMENT OF PHOTOMULTIPLIER TUBES. Report No. 29 [for] May 1, 1958 to November 1, 1958. John Bolakas. 15p. Contract AT(30-1)-1336. $3.30 (ph), $2.40(mf) OTS.

A number of 8-in.-diam. multiplier phototubes are under construction utilizing separable cones. This technique enables one to simplify the tube construction in that the multiplier structure can be inserted into the tube envelope with considerably less difficulty. The use of this technique also tends to reduce the shrinkage rate in building this tube since the faceplate section can be thoroughly checked prior to making the final seal in the tube. The final seal consists of heliarc welding the two sections of the split cone. (auth)

7680 RIB-38
DuMont (Allen B.) Labs., Inc., Clifton, N. J.
THE CONSTRUCTION OF A CASCADED IMAGE CONVERTER FOR NUCLEAR TRACK VIEWING. Quarterly Report No. 1 [for] June 1, 1958 to November 1, 1958. A. L. Bearman. 10p. Contract AT(30-1)-2196. $4.80 (ph), $2.70(mf) OTS.

The design of a cascaded image intensifier is described. The tube is expected to have a light gain of 1000 and a resolution of approximately 2 lines/mm. (A.C.)

7681 SC-4257(TR)
Sandia Corp., Albuquerque, N. Mex.
A STABILIZED TRANSISTOR OSCILLATOR. Thomas F. Marker. Jan. 1959. 18p. Contract AT-(29-1)-789. $0.50(OTS).

The transistorization of the Clapp and Pierce oscillator circuits is discussed with a view to realizing maximum frequency stability. Some circuit equations for conditions of oscillation and fractional frequency deviation from the tuned circuit frequency are derived, and the results of several designs are evaluated. It is shown that stabilities of ±1 part in 10^6 are easily obtainable with simple circuits. (auth)

7682 SCTM-31-58(16)
Sandia Corp., Albuquerque, N. Mex.
A PRELIMINARY STUDY OF MODULATED LIGHT-BEAM AUDIO TRANSMISSION SYSTEMS. R. W. Healy. Sept. 11, 1958. 13p. Contract AT(29-1)-789. $3.30 (ph), $2.40(mf) OTS.

Some of the distance limits of practical transmission, the kinds of intensities of compatible light-beam sources, and the feasibility of communications systems based on light beam transmission were investigated. In addition, the design of the electrical and mechanical apparatus involved is considered. Equipment diagrams and photographs are included. (J.R.D.)

7683 SCTM-389-58(51)
Sandia Corp., Albuquerque, N. Mex.
VARIATIONS OF REMANENT POLARIZATION THROUGH A FERROELECTRIC CERAMIC ELEMENT OF FLOWERPOT GEOMETRY. R. W. Kulterman and A. J. Shell. Nov. 17, 1958. 24p. Contract AT(29-1)-789. $4.80(ph), $2.70(mf) OTS.

The remanent polarization (P_R) of a series of disks cut from a polarized flowerpot design PZT ceramic was measured to determine the variation of P_R with the distance (r) from the center of the flowerpot. These measurements were made under two different geometrical conditions. In one case the disks were sliced from a slug cavitroned from the side of the flowerpot where the symmetry is cylindrical. In the other case the disks were sliced from a slug cavitroned from the end of the flowerpot where the symmetry is spherical. Within the limits of accuracy of the experiment, a $P_R \cdot 1/r$ variation for the cylindrical geometry and a $P_R \sim 1/r^2$ variation

for the spherical geometry were found. This indicates that very little volume charge has been stored in the element. Measurements were also made of the electromechanical coupling coefficient (k_p) for each disk. These data, together with the value of P_R measured for each disk, were used to plot points on a previously established empirical curve of P_R versus k_p. The points agree with the curve, extending the validity of the empirical relationship to these additional geometries. (auth)

7684 SCTM-396-58(14)
Sandia Corp., Albuquerque, N. Mex.
RECEIVING CHARACTERISTICS OF QUASI-SHIELDED ANTENNAS—VLF CASE. Charles W. Harrison, Jr. and David H. Denton, Jr. Oct. 15, 1958. 51p. Contract AT-(29-1)-789. $7.80(ph), $3.30(mf) OTS.

The behavior of electric and magnetic probes in a linearly polarized electric field is determined quantitatively. Formulas are developed permitting calculation of the power in the load impedances in terms of the incident electric field under the following conditions: when the electric and magnetic probes are isolated; when the electric and magnetic probes are in proximity to an infinite, perfectly conducting plane; when the magnetic probe is shadowed by an infinite, imperfectly conducting plane of finite thickness; when the magnetic probe is situated between two infinite, imperfectly conducting plates of finite thickness; and when the magnetic probe is situated between an infinite, imperfectly conducting plate of finite thickness and a parallel, infinite, perfectly conducting plane. A probe is defined as an antenna (dipole or loop) having small dimensions in terms of the wavelength. On the basis of this analysis it is possible to draw some useful conclusions regarding the efficacy of a slotted as well as a nonperforated, imperfectly conducting, cylindrical shield (of small length and radius compared to the wavelength) containing either an electric or magnetic probe. (auth)

7685 SCTM-422-58-(52)
Sandia Corp., Albuquerque, N. Mex.
TELEMETRY RECEPTION CAPABILITIES OF AIRCRAFT RECEIVING STATIONS FROM MISSILES NEAR IMPACT. J. H. Scott, H. O. Jeske, J. E. Hinde, and J. C. Mitchell. Dec. 16, 1958. 24p. Contract AT-(29-1)-789. $4.80(ph), $2.70(mf) OTS.

The results of experimental signal strength measurements made at AFMTC from transmitting antennas, located very close to the water surface, to airborne receiving stations were found to be in close agreement with calculated signal strength levels. The calculations involved the effects of atmospheric refraction, reflection from smooth sea water, and divergence of the reflected wave due to the earth's curvature. The tests pointed out the propagation differences between vertical and horizontal polarization at impact. Results of the tests performed indicate that average signal strength levels on airborne receiving stations can be predicted within 6 db. (auth)

7686 UCRL-8570
California. Univ., Berkeley. Lawrence Radiation Lab.
GAS CHERENKOV COUNTERS. Victor Perez-Mendez and John H. Atkinson. Dec. 23, 1958. 19p. Contract W-7405-eng-48. $0.75(OTS).

A gas Cherenkov counter is described which is suitable for charged particle detection in the Bev region (β from 0.980 to 0.999). Calibrations of the counting efficiency are included along with a table of indices of refraction of suitable gases. The use of this counter as a threshold detector to discriminate between elastic and inelastic pions in the momentum range of 1 to 2 Bev/c is discussed. (auth)

7687 WAPD-CTA(EGD)-551
[Westinghouse Electric Corp. Bettis Plant, Pittsburgh.]
RESULTS OF EVALUATION TEST FOR COAXIAL CABLES SUITABLE FOR NUCLEAR INSTRUMENT APPLICATIONS AND CAPABLE OF OPERATING ABOVE 225°F. William Gernert. [Sept. 1957]. 14p. Project No. 90605. Contract NObs-67500(NS-200-027). $3.30(ph), $2.40(mf) OTS.

Three types of coaxial cables were tested, including a silicone rubber dielectric, a low-pressure polyethylene dielectric, and an irradiated polyethylene dielectric. The rubber cable was least affected by temperature changes and withstood the highest ambient temperature without destructive effects. The leakage of current, however, was too high to be considered for use in nuclear instrument application. The irradiated polyethylene cable was deemed below acceptable standards. The low-pressure polyethylene showed acceptable electrical properties, and it was recommended that this cable, called Super Dyan, be accepted as the basis of minimum performance standard for evaluation of future nuclear instrument coaxial cables. (J.R.D.)

7688 AEC-tr-3532
ON RESOLVING POWER OF SCINTILLATION MULTIPLIERS AND EFFECT OF VARIOUS PARAMETERS ON IT. P. Görlich, A. Krohs, et al. Translated by Lydia Venters (Argonne National Lab.) from Z. angew. Phys. 10, 303-9(1958). 13p. $3.30(ph), $2.40(mf) JCL or LC.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 15745.

7689 AEC-tr-3544
REPRODUCTION OF THE INTERNATIONAL TEMPERATURE SCALE WITH THE AID OF THE OPTICAL PYROMETER. E. A. Lapina. Translated for Los Alamos Scientific Lab. from Trudy Vsesoyuz. Nauch. Issledovatel'. Inst. Metrol., No. 25, 54-65(1955). 11p. $3.30(ph), $2.40(mf) JCL or LC.

The international temperature scale from 1000 to 1800°C was reproduced using a standard optical pyrometer for a single value of the wave length of monochromatic radiation at about 0.65 microns. In addition, a horizontal black body model was constructed which reproduced the solidification temperature, and a new method of the reproduction of the temperature scale at different wave lengths was applied, thus assuring mutual standardization of brightness temperatures at different values of effective wavelength. For the reproduction of the temperature scale above 1400°C, a platinum absorber was used, the pyrometric absorption of which varied uniformly with variation of wavelength. (J.R.D.)

7690 AEC-tr-3556
OBSERVATION OF ROTATING FIELDS. (Observateur de Champs Tournants.) Jacques Ducloz and René Perret. Translated for Atomics International from Compt. rend. 246, 913-16(1958). 7p. (Includes original, 4p.). $1.80(ph), $1.80(mf) JCL or LC.

An oscillograph is described for use in observing a rotating magnetic field. The operation of the device for visual and photographic work is described in detail. (A.C.)

7691 AEC-tr-3557

GROOVE PLAN FOR HARMONICS ACCORDING TO TINGLEY AND THE CALCULATION OF THE WINDING FACTORS. (Nutenplan nach Tingley für Oberwellen und die Berechnung der Wicklunsfaktoren.) M. Bauer. Translated for Atomics International from Elektrotech. u. Maschinenbau 75, No. 4, 69-73(1958). 14p. (Includes original, 5p.). $3.30(ph), $2.40(mf) JCL or LC.

The groove plan for harmonics according to Tingley was developed and applied in the determination of winding factors. (A.C.)

7692 JPRS-791

ATOMIC BATTERIES. V. S. Merkulov. Translated from Izmeritel'naya Tekh., No. 2, 94-7(1958). (PB-141480-T). $0.50(OTS).

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 15694. (C.H.)

7693 NP-tr-216

MEMORY APPARATUS FOR OBSERVING SINGLE EVENTS ON A CATHODE-RAY OSCILLOGRAPH. A. P. Tsitovich and V. I. Efremenko. Translated by P. Collins (U.K.A.E.A., Atomic Energy Research Establishment, Harwell) from Pribory i Tekh. Ekspt., No. 3, 58-61(1958). 9p. (Figures omitted). $1.80(ph), $1.80(mf) JCL or LC.

A method of storing single events based on using the memory of a cathode-ray tube in conjunction with a magnetic drum is described. The basic circuit of the apparatus, which is separate from the oscillograph, is described. The maximum speed observed was 4 μsec for 100 mm of screen with a 18L047 tube. For recording more rapid processes, tubes with larger beam currents can be used. (J.R.D.)

7694

DUST-TRACK MODEL OF CLOUD CHAMBER AND NUCLEAR EMULSION EVENTS. E. W. Cowan (California Inst. of Tech., Pasadena). Am. J. Phys. 27, 118(1959) Feb.

An apparatus for the simulation of charged-particle tracks in a cloud chamber or nuclear emulsion for demonstrations before large groups is described. (A.C.)

7695

DEVICE FOR VARYING BURNER HEIGHT IN BECKMAN FLAME PHOTOMETER. Irving May, Henry Kramer, and Edward L. Curtis (U. S. Geological Survey, Washington). Anal. Chem. 29, 1388(1957) Sept.

An attachment for reproducibly raising or lowering the Beckman atomizer-burner is described. Different parts of the flame can be brought into focus on the slit without changing the mirror adjustment. (J.H.M.)

7696

POINT FOCUSING APPARATUS FOR STUDYING SMALL-ANGLE SCATTERING OF X-RAYS. Kai Siegbahn. Ann. Acad. Regiae Scientiarum Upsaliensis 2, 102-10(1958).

Information is presented on the advantages, design, and application of a point focusing apparatus for studying small-angle scattering of x rays. Special consideration is given to the design of crystal holders that are applicable to the device. In the device, the x-ray beam passes through glass tubes, through which hydrogen gas from a container is flowing. The glass tubes are sealed with thin films, which absorb very little of the x-ray beam. The beam passage through air is about 15 cm. The sample is placed as near the crystal as possible, about 5 cm. The distance between the sample and the photographic plate is 95 cm. Experiments performed with the aid of this device show that it is possible to achieve two-dimensional focusing of x rays, resulting in a sharp point focus of the monochromatic beam. This point focus is remarkably free from undesirable surrounding blackening of the photographic plate, and the conditions for small-angle scattering studies are favorable. (J.H.M.)

7697

THE SELF-QUENCHING GEIGER-MÜLLER COUNTER. H. Gebauer. Atomwirtschaft 4, 21-5(1959) Jan. (In German)

The characteristics of Geiger-Müller counters are influenced by various factors, in particular by the diameters of the anode and cathode and by the composition of the filling gas. The most common type is the self-quenching G-M counter containing an organic vapor, e.g., a mixture of argon and alcohol. The differing properties of halogen counters indicate a different discharge mechanism. A special treatment is often necessary for the construction materials on account of the purity of the counter gases. (auth)

7698

COLLECTION OF GAS-BORNE DUST PARTICLES BY MEANS OF AN ASPIRATED SAMPLING NOZZLE. S. Badzioch (British Coal Utilisation Research Association, Leatherhead, Surrey, Eng.). Brit. J. Appl. Phys. 10, 26-32(1959) Jan.

The efficiency of collection of gas-borne particles by an aspirated sampling nozzle is investigated theoretically and experimentally. The efficiency is shown theoretically to depend on (a) the ratio of the velocity of aspiration into the sampling nozzle to the velocity of the undisturbed gas stream, and (b) the ratio of a length representing the distance of disturbance upstream of the nozzle to the "range" of a particle. The "range" is defined as the distance a particle would travel, before coming to rest, if projected into still gas with a velocity equal to that of the gas stream. In the range of conditions investigated experimentally, which included nozzles of 0.65 to 1.90 cm diameter aspirating from turbulent gas streams, it is found that the length representing the upstream disturbance is a function of the diameter of the nozzle. (auth)

7699

SCINTILLATION COUNTING APPARATUS OF HIGH STABILITY FOR THE COUNTING OF β PARTICLES. Y. Koechlin. Bull. inform. sci. et tech. No. 17, 2-7 (1958) May. (In French)

A series of detectors for the scintillation counting of β particles of high energy is described. This series shows a counting efficiency which compares with Geiger 4π counters and a counting stability of about 0.5 per cent for several hours. Those characteristics are obtained with plastic scintillators, mounted with special light traps, and with Dario 51 AVP photomultipliers. The stability is reached by means of a prestabilization of the mains (0.5 per cent) and of the temperature of the counting chain (±1°C). (auth)

7700

MEASUREMENT OF THE RESPONSE TIME OF THE PHOTOMULTIPLIER L.E.P. TYPE 204. Y. Koechlin (C. E. N., Saclay, France). Bull. inform. sci. et tech. No. 23, 2-10(1958) Nov. (In French)

The experimental results obtained with the type 204 photomultipliers are given. The form of the anodic impulses was analyzed. The anodic impulse corresponding to the emission of a single photoelectron from the photocathode was determined, and a measurement of the fluctuations of the transit time of the photomultiplier was thus obtained. The impulse coming from the emission of several photoelectrons projected simultaneously by the cathode was analyzed. A measurement of the fluctuations of the transit time between the photocathode, first dynode, and multiplier was obtained. The variations of isochronism between the center and the edge of the photocathode were analyzed. The experimental results are in agreement with the calculated results and show that the photomultiplier, when associated with an adequate electronic circuit, has a resolution time better than a millimicrosecond. (tr-auth)

7701

HYDROMAGNETIC CAPACITOR. Oscar Anderson, William R. Baker, Alexander Bratenahl, Harold P. Furth, and Wulf B. Kunkel (Univ. of California, Berkeley). J. Appl. Phys. 30, 188-96(1959) Feb.

Very high dielectric constants can easily be achieved by means of an ionized gas in a strong magnetic field. When an orthogonal electric field is applied, the resultant particle drift stores electrical energy. In a coaxial capacitor, which makes use of a rotating plasma disk, dielectric constants in the range 10^6 to 10^8 have been measured. The potential usefulness of hydromagnetic capacitors in fast-discharge work is considered. (auth)

7702

MULTIPLE GEIGER COUNTER TELESCOPE MEASUREMENTS OF THE DIRECTIONS OF AIR SHOWER PARTICLES. H. D. Rathgeber (Univ. of Sydney). Nature 183, 386-7(1959) Feb. 7.

An experiment on the use of a multiple Geiger counter telescope for measuring the directions of air shower particles is discussed. The experimental arrangement consisted of two Geiger counter telescopes, separated by 1 m, which could be tilted independently around an east-west axis. Each telescope consisted of two counters, 20 cm long and of 3 cm diameter, separated by 14 cm. A third counter could be introduced either in line or just outside the space joining the two outermost counters. The resolving time of 8 μsec gives a rate of accidental counts of 10^{-3} per hr for both the fourfold and sixfold coincidences, the main contribution being the accidental coincidences between the two telescopes. Results of measurements made in a tent at an altitude of 1,750 m are given. Conclusions indicate that such an arrangement of Geiger counters as was used does not respond selectively to showers incident within the opening angle of ±12° of the telescope. (J.H.M.)

7703

RADIATION DETECTORS. 1. THEIR OPERATING PRINCIPLES. A. L. Gray (Plessey Nucleonics, Ltd.). Nuclear Power 4, 74-7(1959) Feb.

The purpose of this article is to review the range of radiation detectors available and to consider their application. Basic methods of detection as a background to a detailed consideration of detector characteristics are described. (W.L.H.)

7704

A CONTROL ROD POSITION INDICATOR. A. W. Fenton (United Kingdom Atomic Energy Authority, Capenhurst, Eng.). Nuclear Power 4, 85-6(1959) Feb.

An instrument is described for indicating the position of the control rod within a sealed reactor based on the principle of variation of electrical inductance. The control rod moves vertically and is provided with an extension piece. On this rests a ferromagnetic plunger, moving vertically and making a loose fit within a stainless steel tube which forms part of the pressure shell of the reactor. In the outside of the tube is a coil system; the movement of the rod, and the plunger, causes changes in the inductance in the coils, which give the measurements of rod position. (W.L.H.)

7705

ACTIVITY MEASUREMENTS ON FLUX-SCANNING WIRES. W. Abson and M. Awcock (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Power 4, 89-90(1959) Feb.

Two ionization chambers were designed for the measurement of activation in wires, to meet flux scanning requirements in graphite-moderated reactors with core sizes of 10 feet or more and in reactors of the heavy water type with cores about 2 feet in length. In both cases it was necessary to be able to measure flux densities over a range of about 100:1 at power levels ranging from full power to at least 10^{-2} of maximum power. (W.L.H.)

7706

ERROR SOURCE BY YIELD PERTURBATIONS IN THE ACTIVATION MEASUREMENTS IN RADIOCHEMICAL PREPARATIONS IN FLOW-THROUGH COUNTERS. A. Spang and W. Gebauhr (Siemens-Schuckertwerke AG, Erlangen, Ger.). Nukleonika 1, 160-4(1958) Dec. (In German)

The analytical practices for fall-out collected on round filters produce very scattered results in activation measurements in flow-through counters. The scattering lies considerably outside the normal statistical error range. The origin of these deviations was traced back to the isolated filter material and the isolated fall-out which bring field perturbations in the sensitive counter volume. The uncontrollable variations can be eliminated by vapor deposition of a conducting silver layer. This procedure does not impair the chemical analytical separation methods and leads, in a 2π measurement, to reproducible results. (tr-auth)

7707

PLATEAUGRAPH FOR G-M COUNTERS TYPE R-Pts-1. A. Janikowski. Nukleonika 3, 471-3(1958). (In Polish)

The technical data, design, and performance of a recorder operating with a G-M counter are described. A plateau potential of 400 v gave a count rate of 15/sec for 5 to 6 min. (R.V.J.)

7708

DETERMINATION OF C^{14} IN GEIGER-MUELLER COUNTERS FILLED WITH CO_2 OR CO WITH HEAVY SATURATED HYDROCARBON. I. Zlotowski and M. Zieliński (Warsaw Univ.). Nukleonika 3, 529-46 (1958). (In Polish)

Measurements of radiocarbon as CO_2 and as CO in Geiger-Mueller counters filled with a mixture of gaseous radioactive carbon compounds and a small quantity of the saturated hydrocarbons vapors, of n. hexane, n. heptane, n. octane, cyclohexane showed that counters filled with vapor of saturated hydrocarbons, pure or mixed with a carbon oxide or a carbon dioxide, are self-quenching counters and have good characteristic curves. Experiments indicated that the partial pressure of carbon oxide cannot exceed the partial

pressure of quenching hydrocarbon in the counter. Setting up a resistance the order of 100 Megohm between the anode wire of the counter and its supply of the potential the resolving time is 3 to 6×10^{-4} sec., and the plateau region from 200 up to 600 v with the slope less than 3% per 100 v at the counting rates of a few thousand counts per minute. Within the statistical errors the measured activity was proportional to the partial pressure of labeled gaseous radioactive substances (CO_2 or CO) in the counter. (tr-auth)

7709

BF_3 NEUTRON COUNTERS OF NUM-12, NUM-30, NUM-72, NUM-12W, NUM-30W, AND NUM-72W. A. Kazimierski (Inst. of Nuclear Research, Polish Academy of Sciences). Nukleonika 3, 599-605(1958). (In Polish)

Descriptions are given of the design and performance of BF_3 ionization chambers. (R.V.J.)

7710

AEROSOL FILTERS FOR RADIOACTIVE SUBSTANCES. Z. Smal, J. Schen, and J. Maciejewski. Nukleonika 3, 673-8(1958). (In Polish)

Descriptions are presented of sectional and perforated cylinder-type filters for radioactive aerosols. (R.V.J.)

7711

THE USE OF METHYL IODIDE-PROPANE MIXTURES AND TRI-FLUORO BROMO METHANE AS BUBBLE CHAMBER FLUIDS. F. W. Bullock, C. Dodd, and G. E. Kalmus (University Coll., London). Nuovo cimento (10) 10, 718-20(1958) Nov. 16.

The suitability of a methyl iodide–propane system as a heavy liquid bubble chamber medium was investigated. Operating conditions were found for various mixtures, and also for trifluorobromomethane, another possible heavy liquid medium. (auth)

7712

CHARGE SYMMETRY OF WEAK INTERACTIONS. Steven Weinberg (Columbia Univ., New York). Phys. Rev. 112, 1375-9(1958) Nov. 15.

The invariance of strong interactions under G, the product of charge symmetry and charge conjugation, has important consequences for strangeness-conserving lepton interactions. According to the G-transformation properties of the strongly interacting currents, we may divide the primary weak interactions into two classes. The first class includes the conventional nucleon-lepton Fermi interaction, and is the only class that contributes to the β-decay coupling constants. Unambiguous tests for the existence of second-class interactions include: (a) induced scalar term in μ^- absorption, (b) inequality of certain small correction terms in B^{12} and N^{12}, or in Li^8 and B^8 β decay, and (c) inequality in rates of $\Sigma^+ \rightarrow \Lambda^0 + e^+ + \nu$. Absence of second-class interactions would indicate a deep relation between isotopic spin and weak interactions; for example, the recent Feynman-Gell-Mann theory predicts that all vector weak interactions are first class. The presence of second-class interactions would mean that the usual Fermi interaction is insufficient, and must be supplemented by terms involving strange particles. Some general remarks are also made about the relations between $(l^-,\bar{\nu})$ and (l^+,ν) processes, and we prove the following useful theorem: no interference between V and A may occur in any experiment which treats both leptons identically and in which no parity nonconservation effects are measured, providing that we may neglect the mass and charge of the leptons. (auth)

7713

CALORIMETRIC MEASUREMENTS ON A CESIUM-137 TELETHERAPY UNIT. Paul N. Goodwin (Royal Cancer Hospital, London). Radiation Research 10, 6-12(1959) Jan.

The power in the γ-ray beam from a Cs^{137} teletherapy unit has been measured with a calorimeter. Comparison with ionization measurements gives a conversion factor of 2959 ± 44 ergs/cm^2/r, and combining this result with the calculated absorption coefficient gives a value for W of 33.9 ± 0.5 ev/ion pair. (auth)

7714

EXTENDED RANGE DISTRIBUTED AMPLIFIER DESIGN. John J. Eichholz, Carl F. Nelson, and Gerhard T. Weiss (Argonne National Lab., Lemont, Ill.). Rev. Sci. Instr. 30, 1-6(1959) Jan.

A distributed amplifier employing a straight wire transmission line is described. The amplifier has a gain of 15 ± 3 db from 10 to 400 Mc, and input and output impedances of 50 Ω. Detailed electrical and mechanical design considerations are included. (auth)

7715

SECOND ORDER CONTAMINATION IN A NEUTRON CRYSTAL SPECTROMETER. R. Haas and F. J. Shore (Brookhaven National Lab., Upton, N. Y.). Rev. Sci. Instr. 30, 17-21(1959) Jan.

The second-order contamination in the BNL neutron crystal spectrometer is measured for the NaCl(220), NaCl(240), Be(10$\bar{1}$1), and Be(12$\bar{3}$1) reflections over the energy range 0.08 to 5 ev. Reflectivity calculations by Holm for neutrons incident on thin crystals of Be and NaCl are verified experimentally. A method is suggested for rapidly calculating the second-order fraction of the beam using a simple count rate spectrum and the calculated crystal reflectivities. (auth)

7716

CONCERNING AMIDOL DEVELOPMENT OF NUCLEAR EMULSIONS. G. D. Fatzer (Laboratoire de Recherches nucleaires, Lausanne, Switzerland). Rev. Sci. Instr. 30, 22-7(1959) Jan.

A lowering of the development temperature introduces development defects which are characterized by the partial or total destruction of the developed image and by a deep coloration of the emulsion. These defects are eliminated by increasing the sodium sulfite concentration of the developer. Up to now contrast in nuclear emulsions has been evaluated subjectively by the experimenter; this forbids any comparison of the results obtained in different laboratories. It is shown that reliable low-temperature development with the usual developers requires an increase in the ratio (Na_2SO_3)/(Amidol). For development temperatures of 10 to 15°C the concentration ratio needs to be 70% greater than the ones commonly used. A study of track and fog grain properties is carried out. It is shown that at a given temperature the mean gap length is practically independent of the development parameters. The optimum conditions at 14°C are determined with the help of a new quantity termed "track visibility" (K), a track to fog signal, and defined by K = blob length × track grain diameter/fog × (fog grain diameter).^{2} (auth)

7717

GENERATOR OF NANOSECOND LIGHT PULSES FOR PHOTOTUBE TESTING. Quentin A. Kerns, Frederick

A. Kirsten, and Gerald C. Cox (Univ. of California, Berkeley). Rev. Sci. Instr. 30, 31-6(1959) Jan.

This mercury-capsule light-pulse generator was developed to test and evaluate the high-speed features of multiplier phototubes and low-level image tubes. Light pulses and electrical trigger pulses are generated simultaneously in an arc discharge at a usual repetition rate of 60 per second. The electrical pulse is used as a time reference for the light pulse. The time required for both the light and the electrical pulse to rise from 10 to 90% of peak amplitude is less than 5×10^{-10} sec. The light pulse rises to a maximum and falls to 50% peak amplitude in less than 1.5×10^{-9} sec. The electrical pulse power available is large. Time resolution of 10^{-10} sec is typical of measurements made with conventional fast oscilloscopes, while elaboration of technique permits relative time measurements that are better in some cases by at least three orders of magnitude. The light is emitted from a region a few mils in diameter, and thus may often be considered to come from a point source. An S4 photosurface subtending 0.1 sterad at the light source emits photoelectrically about 10^7 electrons per sterad per pulse. For convenience, three decoupled electrical output channels are provided, together with a Polaroid attenuator for the light pulse. (auth)

7718

LIQUID SCINTILLATOR LUMINOSITY AS AN INDICATOR FOR OXYGEN IN GASES. D. J. Chleck, J. Brinkerhoff, W. Hadley, and C. A. Ziegler (Tracerlab, Inc., Waltham, Mass.). Rev. Sci. Instr. 30, 37-8 (1959) Jan.

Preliminary work has been done on an oxygen measuring system which will be adaptable to oxygen concentrations from 0.1% to 100% O_2. The system, based on the effect of molecular oxygen on luminosity in liquid scintillation solutions, employs an organic phosphor excited by a Sr^{90} source. (A.C.)

7719

NONHYSTERESIS RESET CIRCUIT FOR NUCLEAR REACTOR SAFETY INSTRUMENTS. Charles Erwin Cohn (Argonne National Lab., Lemont, Ill.). Rev. Sci. Instr. 30, 42-3(1959) Jan.

A nonhysteresis reset circuit for nuclear reactor safety instruments is described. This arrangement eliminated the troublesome hysteresis effect present in relays. This scheme essentially gives the instrument zero hysteresis, since it allows resetting with the signal just barely below scram level. (A.C.)

7720

SIMPLE AUTORADIOGRAPHIC TECHNIQUE. T. K. Bierlein and B. Mastel (General Electric Co., Richland, Wash.). Rev. Sci. Instr. 30, 46-7(1959) Jan.

A new autoradiographic technique is described which offers excellent definition, contrast, and correlation of tracks. The emulsion may be attached to a microscope glass slide and photographed through a microscope. (A.C.)

7721

BETATRON EMISSION DETECTOR. V. A. Moskalev. Vestnik Rentgenol. Radiol. No. 6, 63-4(1958). (In Russian)

A design is presented of a portable detector for use with betatrons. The portable unit consists of a 1 cm^3 ionization chamber with graphite walls. The unit is connected by a cable to the main accelerator direct current at the entrance near the microammeter. The apparatus is supplied by a stabilized voltage source. (R.V.J.)

7722

A LOW NOISE BALLISTIC PREAMPLIFIER FOR IONIZATION CHAMBERS AND COUNTERS. H. Schlumbohm (Univ. of Hamburg). Z. angew. Phys. 10, 551-3(1958) Dec. (In German)

Experiences in the building of a low-noise preamplifier with high input sensitivity are presented. The tube used as input tube was the E 83 F connected as the triode. The network determining the frequency curve of the amplifier consists of two RC filters with equal time constants. The optimum signal-to-noise ratio was determined experimentally and was in good agreement with the calculated value. The effective noise of the input tube was 270 ion pairs at an input capacitance of 20 pf. (tr-auth)

7723

AN INTRODUCTION TO RADIATION COUNTERS AND DETECTORS. C. C. H. Washtell. London, George Newnes Limited, 1958. 123p.

Information is presented on the applications, design, and operating characteristics of radiation detectors and measurement techniques. A review is given of the historical background of radioactivity and atomic structure. Chapters are devoted to discussions on Geiger-Mueller tubes and other types of detectors based on ion collection and dosimetry. (J.H.M.)

7724

RADIOACTIVITY MEASURING INSTRUMENTS. A Guide to Their Construction and Use. M. C. Nokes. New York, Philosophical Library, 1958. 80p.

This book is an attempt to show how instruments of fair accuracy can be made with the minimum of expense and without the consumption of too much time. Some rather more complicated circuits are included for those who may wish to make a simple scaler, or to experiment with some of the more recent counting devices. (W.D.M.)

METALLURGY AND CERAMICS

Refer also to abstracts 8346, 8347, 8348, 8355, 8358, 8368, 8372, 8373, 8379, 8382, 8389, 8425, 8427, 8436, and 8439.

7725 AECU-3996

Chicago. Univ. Inst. for the Study of Metals.
FIELD EMISSION FROM METAL WHISKERS. A. J. Melmed and R. Gomer. [1958]. 5p. Contract AT(11-1)-604. $1.80(ph), $1.80(mf) OTS.

Vapor grown single crystal whiskers were produced from Al, Cu, Fe, Ni, Si, Mo, and C. The technique is described, and it is pointed out that it enlarges the scope of field and ion microscopy. Involatile impurities can be eliminated making it possible to grow clean emitters of almost any material in high vacuum. (J.R.D.)

7726 AFOSR-TR-59-10

Midwest Research Inst., Kansas City, Mo.
A RADIOACTIVE TRACER INVESTIGATION OF THE MECHANISM OF MoS_2 AND WS_2 LUBRICATION. M. T. Lavik and S. L. Levy. June 1958. 9p. Contract AF49(638)-157. (AD-209493).

Johnson's hypothesis describing lubrication by molybdenum disulfide was examined. This hypothesis credited the lubricative properties of MoS_2 to the pres-

ence of an adsorbed sulfur layer supplied by mechanical breakdown of the MoS_2. Specifically, radioactive sulfur in an MoS_2 film was used to allow the application of sensitive, beta counting techniques in detecting the presence of minute quantities of sulfur evaporated from the test track during the time following a friction test run. The Johnson hypothesis explains that the increase in coefficient of friction which has been observed after stopping a friction run is due to the evaporation of the adsorbed sulfur film from the test track. The sulfur thus evaporated would be collected on a cold trap in the vacuum system and thence quantitatively measured through its emission activity. The measurements were carried out in the friction test chamber and associated vacuum system used by Johnson, et al., in their earlier work in friction on the sulfides. The equipment was modified to include facilities for collection and detection of the evaporated sulfur. The molybdenum disulfide pellets were activated by neutron irradiation after preparation in pellet form and were then placed in the machine for measurements. Observations following various friction runs indicated the presence of some sulfur condensed on the cold system. However, the number of counts measured above background for various friction runs is insufficient for the development of firm conclusions on the project. (auth)

7727 BMI-1243

Battelle Memorial Inst., Columbus, Ohio.

DELTA-PHASE ZIRCONIUM HYDRIDE AS A SOLID MODERATOR. James B. Vetrano. Dec. 18, 1957. Decl. Feb. 11, 1959. 13p. Contract W-7405-eng-92. $3.30(ph), $2.40(mf) OTS.

In a study of the preparation and properties of delta-phase zirconium hydride it was found that large, sound bodies of the hydride can be prepared by direct combination of the elements if the rate of the reaction is retarded by limiting the supply of available hydrogen. Specimens up to 1-in. diameter were prepared using this technique. Because delta-phase zirconium hydride does not readily form eutectics with iron- and nickel-base alloys below 1800°F these materials may be utilized for cladding the hydride. Delta-phase zirconium hydride is unaffected by exposure to liquid NaK or to nitrogen gas at temperatures below 1000°F. The hot hardness of delta-phase zirconium hydride is about 130 kg per mm^2 at room temperature and 40 kg per mm^2 at 1500°F. The mean coefficient of thermal expansion (68 to 1337F) is 6.5×10^{-6} per deg F. The thermal conductivity varies from 5.7 Btu/(ft)(hr)(F) at 300°F to 5.1 Btu/(ft)(hr)(F) at 1300°F. (auth)

7728 BMI-1253

Battelle Memorial Inst., Columbus, Ohio.

PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING JANUARY 1958. Russell W. Dayton and Clyde R. Tipton, Jr. Feb. 1, 1958. Decl. July 18, 1958. 51p. Contract W-7405-eng-92. $1.75(OTS).

Data are given on: creep properties of 15% cold-worked Zircaloy-2; the liquidus in Al–U; effect of chloride on corrosion of type 304 ELC stainless steel; corrosion testing of stainless steels, Ti 75A, lead, and rigid PVC as container materials for HNO_3-recovery process; viscosities of MgF_2 and MgF_2–MgO slags; phase boundaries in the U–Zr–H system; oxidation of Nb, Nb–W, and Nb–V alloys in dry air at 1000 and 1200°C; nonoxidizing properties of UO_2–La_2O_3 and UO_2–Sc_2O_3; study of bonding fundamentals; hydrogen adsorption by Nb; diffusion of H in ZrH_4; reflector-controlled heterogeneous boiling reactor; pressure bonding of Zircaloy-2-clad compartmented UO_2 fuel plates for PWR; and evaluation of UC as reactor fuel. (For preceding period see BMI-1247.) (T.R.H.)

7729 BMI-1304

Battelle Memorial Inst., Columbus, Ohio.

PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING NOVEMBER, 1958. Russell W. Dayton and Clyde R. Tipton, Jr. Dec. 1, 1958. Decl. Jan. 7, 1959. 53p. Contract W-7405-eng-92. $1.75(OTS).

The effect of irradiation on the thermal conductivity and electrical resistivity of U and UO_2 is being investigated. The creep properties of 15% cold-worked Zircaloy-2 are being investigated in the 290 to 400°C temperature range for times exceeding 10,000 hr. The density distribution of crushed graphite is being investigated by the sink-float method. Centrifugal-casting techniques for the production of Al–35 wt. % U casting in the form of hollow cylinders are being investigated. A study of the processes involved in the solidification of U castings in graphite molds is being made. Work continued on electrolytic oxide and electroless oxide coatings on Croloy-2¼. Experimental work was continued to determine the effect of additive oxides on the oxidation characteristics and phase stability of UO_2. The fueled-moderator study has continued with the determination of additional hydrogen-absorption isotherms for the Zr–25 wt. % alloy and high-temperature x-ray diffraction patterns of hydrides of the 1 and 50 wt. % alloys. The irradiation of type 347 stainless steel at ETR process-water temperature, about 120°F and at 600°F, and subsequent determination of irradiation damage are being done in support of the KAPL-33 loop to be installed at the ETR. Alloys of U and Nb are being considered as possible high-temperature reactor fuels. Thorium–uranium base alloys are the subject of an investigation aimed at improving irradiation stability and corrosion resistance by ternary alloying and control of processing techniques. Cermet fuel materials consisting of from 60 to 90 vol. % UO_2, UN, or UC dispersed in stainless steel are being investigated. Several types of 1½-inch-diameter fueled graphite spheres containing 10 wt. % of fully enriched UO_2 are being evaluated before and after irradiation in the BRR. Some localized attack has been observed after prolonged exposure of Ti steam tubes to initial and beginning Darex solutions. Heat treating stabilized Nionel, prior to welding, has improved the resistance of weldments to initial Thorex solutions. Experiments are being conducted to determine the suitability of UC as a fuel for the SRE. Reports of progress are included in the irradiation, postirradiation-examination, and gas-releasing study of various capsules and specimens. All parts of the program for postirradiation examination of Th–11 wt. % U specimens have been completed except for metallography. Postirradiation inspection of the UO_2 fuel pins has been completed. Postirradiation examination of the 25 wt. % UO_2–stainless steel fuel element, OMRE-3, has been completed except for additional metallographic examinations. In the container-material research, high-quality Ta and Ta–W specimens have been prepared by arc melting, and strip-fabrication operations on the specimens have started. A compartmentalized Zircaloy-2-clad flat fuel element containing UO_2 cores is being considered for the PWR Core 2. A one-capsule irradiation program to evaluate the compatibility of graphite and CO_2 with types 310 and 446 stainless steels

and with Inconel is nearing completion. (For preceding period see BMI-1301.) (W.L.H.)

7730 CF-58-10-84

Oak Ridge National Lab., Tenn.

EXAMINATION OF CORE ACCESS FLANGE SPECIMEN AND SCALES FROM HRE-2 AFTER RUN 16. A. R. Olsen. Oct. 28, 1958. 14p. Contract [W-7405-eng-26]. $3.30(ph), $2.40(mf) OTS.

Observations, weight data, and chemical analyses of scales on the core access flange and attached specimen assembly exposed in HRE-2 during reactor runs 15 and 16 are reported. The stainless steel specimen showed a very small weight loss. All surfaces exposed to the reactor solution were covered with an unusual two-layer scale. (auth)

7731 CF-58-10-95

Oak Ridge National Lab., Tenn.

QUARTERLY REPORT OF THE SOLUTION MATERIALS SECTION FOR THE PERIOD ENDING OCTOBER 31, 1958. J. C. Griess, H. C. Savage, R. S. Greeley, J. L. English, S. E. Bolt, D. N. Hess, P. D. Neumann, E. S. Snavely, W. C. Ulrich, and N. E. Wisdom. 67p. Contract [W-7405-eng-26]. $10.80 (ph OTS); $3.90(mf OTS).

A simulated HRT fuel solution was unstable when passed through a heated Zircaloy-2 bypass section installed on a Ti loop. Losses of uranyl, cupric, and nickel sulfates were observed when the temperature of the solution emerging from the bypass was as low as 290°C. The 0.04 m UO_2SO_4 solutions containing 0.025 m D_2SO_4 and 0.03 m $CuSO_4$ in heavy water were not completely stable at 300°C when either 0.04 m Na_2SO_4 or 0.04 m K_2SO_4 was added to the solution. The rate at which Cr^{3+} is oxidized to Cr^{6+} in a Ru-containing UO_2SO_4 solution was measured at 225, 250, and 275°C. The effect of cold work and heat treatment on type 347 stainless steel was investigated. Tests run in chloride-containing water at 200°C showed that both phosphate and fluoride ions partially inhibited stress-corrosion cracking of type 347 stainless steel, but neither was completely effective. Stress-corrosion cracking of type 347 stainless steel occurs in most cases upon exposure to 0.04 m UO_2SO_4–0.02 m H_2SO_4–0.005 m $CuSO_4$ solution containing chloride ions at atmospheric boiling temperature. In chloride- and oxygen-containing water at 300°C, all type 347 stainless steel U-bend specimens developed cracks in 500 hr or less whether the surface had been electropolished, pickled, or had been left covered with a heavy oxide scale. Cast type 347 stainless steel specimens have shown no susceptibility to cracking in either boiling 42% $MgCl_2$ or in high-temperature chloride-containing water. Wrought type 347 stainless steel and Zircaloy-2 U-bend specimens have not cracked during exposure to oxygenated ThO_2 slurries containing 100 ppm chloride at 300°C. Corrosion tests with Multimet showed it to be more resistant to stress-corrosion cracking than type 347 stainless steel. Specimens of nitrided titanium and Zircaloy-2 were subjected to test in a simulated fuel solution and in water at 300°C. (For preceding period see CF-58-7-132.) (W.L.H.)

7732 DL-34

Atomic Energy of Canada Ltd., Chalk River, Ont.

URANIUM DIOXIDE. W. B. Lewis. Dec. 1, 1958. 7p. (AECL-733). $0.20(AECL).

Presented at the American Nuclear Society Meeting, Detroit, Dec. 8, 1958.

A general discussion of uranium dioxide as the emerging preferred reactor fuel is presented. The reasons for the preference are given as well as the greatest shortcoming of UO_2, that of low heat conductivity. In addition, the problem of burn-up is considered, and courses of action leading to its solution are given. It is pointed out that progress in the field of atomic power is held back by limited technology, and to make solid progress it is necessary to probe and probe again. Careful cross-checks should be arranged between laboratories for establishing measurements. (J.R.D.)

7733 DMIC-Memo-7

Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.

IMPLICATIONS OF RHENIUM RESEARCH IN THE DESIGN OF REFRACTORY ALLOYS. Feb. 2, 1959. 4p.

This report is made up of notes from a talk presented by R. I. Jaffee, at "Symposium on Ultrahigh-Temperature Material," held at General Motors Corp., Indianapolis, Sept. 11 and 12, 1958.

7734 DMIC-Memo-8

Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.

ELEVATED-TEMPERATURE MECHANICAL PROPERTIES AND OXIDATION RESISTANCE OF COLUMBIUM AND ITS ALLOYS. F. R. Schwartzberg and W. D. Klopp. Feb. 4, 1959. 10p.

A brief review is presented of significant data on the mechanical properties and oxidation behavior of niobium and niobium alloys at elevated temperatures. 28 references. (J.E.D.)

7735 HW-32727

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

COMPARATIVE DATA ON THE CORROSION RESISTANCE OF SELECTED TYPES OF 18-8 CHROMIUM–NICKEL STAINLESS STEELS. K. L. Sanborn. Aug. 12, 1954. Decl. Feb. 3, 1959. 27p. Contract [W-31-109-Eng-52]. $4.80(ph), $2.70(mf) OTS.

Stainless steels, including type 347, 321, 304L, and 347 with NbTa additive, were corrosion tested according to standard industrial acceptance and in liquids which simulate HAPO process streams. It was concluded that there are many services at HAPO in which these steels may be applied interchangeably; however, type 347 with NbTa has disadvantages from the stand point of welding. It was recommended that the Huey test be imposed in specifications for the procurement of 18-8 chromium–nickel stainless steels used in all but specifically excepted separations services. (J.R.D.)

7736 HW-57274

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

INSTABILITY OF STEEL BOTTOMS IN WASTE STORAGE TANKS. L. E. Brownell. Aug. 29, 1958. 26p. Contract [W-31-109-Eng-52]. $4.80(ph), $2.70(mf) OTS.

In June 1958 measurements on Hanford waste storage tank 113-SX showed an upward dishing of the tank bottom to a height of about 4 feet, followed by a return of the liner to a horizontal position later in the month. It was thought that vapor pressure between the steel liner and the concrete bottom caused the dishing, with a subsequent pressure release allowing the liner to return to a horizontal position. Suggestions for storage tank design changes are presented, as well as procedures for

preparing 113-SX for reuse. In addition, procedures are suggested for filling other existing tanks in SX and Purex tank farms, and the reuse of empty tanks built before 1949. (J.R.D.)

7737 HW-57342

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PLUTONIUM FUELS DEVELOPMENT—PLUTONIUM METALLURGY OPERATION QUARTERLY REPORT FOR APRIL, MAY, JUNE 1958. O. J. Wick. Sept. 10, 1958. 31p. Contract W-31-109-Eng-52. $4.80(ph), $2.70(mf) OTS.

Radiometallurgical examination of the last two capsules irradiated in the MTR to 55 to 60% burnup of the Pu atom is complete. These capsules contained Al–1.65 wt. % Pu and Al–12 wt. % Si–1.65 wt. % Pu alloy cores. Assembly is in progress on two four-rod Al–8 wt. % Pu and Al–12 wt. % Si–8 wt. % Pu alloy clusters for irradiation in the 250°C water of the KER loop facility. A pyrometallurgical process for recycling irradiated Pu–Al fuels has been tested on unirradiated materials. Injection casting of Al–Pu alloy into Zircaloy-clad tubes is being investigated as a fuel fabrication technique. Mixed crystal oxides of U and Pu in a ratio of one to five have been processed to form pellets having a green density of 63% of theoretical with an L/D value of 1.3. Assembly was completed on the first model of a new 19-rod cluster design designated the Mark-IB. Improved techniques were devised for the welded closures on Zircaloy tubing and for the attachment of Zircaloy spacer wires to the Zircaloy end caps by Heliarc spot welding techniques. (W.L.H.)

7738 LA-2233

Los Alamos Scientific Lab., N. Mex.

THE ROLLING PRESSURES OF URANIUM SHEET AND PLATE. J. E. Hockett, J. E. Hoehne, and R. K. Bates. 159p. Contract W-7405-eng-36. $3.00(OTS).

A cam plastometer was built and used for testing depleted uranium specimens in compression at several constant true strain rates and temperatures. From load and time measurements, true stress versus true strain curves were calculated. These curves fit an equation of the form $\sigma = A(1-e^{B\epsilon}) + C\epsilon$, where σ is true stress, ϵ is true strain, and A, B, and C are parameters. The parameter B appeared to be constant, or nearly so, at the temperatures and strain rates investigated. The parameters A and C were found to be temperature dependent, and this dependence was determined. All data, whether from a single test or from pools of tests, were fit to curves of the listed equation form by a least-squares method using IBM 704 Electronic Data Processing Machines. The temperature dependence of the parameters A and C was used to calculate the true stress for any given true strain in roll pressure calculations. Orowan's method, modified to take into account both roll flattening and inhomogeneity of deformation, was used to calculate the roll pressure distribution along the arc of contact during the rolling of depleted uranium into sheet and plate. Also calculated were the total roll pressure, total roll separating force, total torque, power requirements, neutral angle and height, and instantaneous values of the true strain rate and the compression rate. Results of roll pressure calculations were compared to some roll separating forces measured by the author. A sample roll pressure calculation for rolling depleted uranium plate into thin sheet was then presented. All roll pressure calculations were done on IBM 704 electronic computers. The work shows how adequate testing equipment and modern computing methods may be utilized to provide rolling mill designers with enough information, of sufficient accuracy, to permit them to design a rolling mill for any specific application. The effect of such factors as roll diameter, roll flattening, coefficient of friction, temperature, and speed of rolling on the behavior and power requirements of a rolling mill may be investigated by Orowan's method combined with rapid electronic computers, as was shown. (auth)

7739 LMSD-2360

Lockheed Aircraft Corp. Missile Systems Div., Sunnyvale, Calif.

A STUDY OF CREEP COLLAPSE OF A LONG CYLINDER UNDER UNIFORM EXTERNAL PRESSURE. N. J. Hoff, W. E. Jahsman, and W. Nachbar. Mar. 28, 1958. 32p.

Equations are developed for the time behavior of the shape of cross section of a long thin-walled cylindrical shell under uniform external pressure. The shell material is assumed to exhibit only secondary creep deformations, and the cross section is constrained to distort in a two-lobe mode. The shell wall construction is of the sandwich type, with concentric cylindrical sheets supporting the normal loads, and the annular core supporting the shear loads. Explicit solutions are obtained for the particular case of a cubic creep law, and curves of the amplitude of the cross-section shape factor vs. time, and of collapse time vs. initial amplitude are presented. The variation in the collapse time due to initial uncertainties in the initial amplitude is also derived and plotted. (auth)

7740 NAA-SR-192

North American Aviation, Inc., Downey, Calif.

CORROSION OF REFRACTORIES BY TIN AND BISMUTH. T. A. Coultas. Sept. 15, 1952. Decl. Aug. 13, 1956. 23p. Contract AT-11-1-GEN-8. $4.80(ph), $2.70(mf) OTS.

Static corrosion tests were made on several refractory materials in tin and bismuth at 1800°F. The materials tested in tin, listed in decreasing order of resistance to attack, were: graphite, Al_2O_3, Vycor, W, $MoSi_2$, TaC, Kennametal K-138A, Haynes Metamic LT-1, Ta, and Mo. The materials tested in bismuth, with those most resistant to attack listed first, were: graphite, Al_2O_3, ZrO_2, ThO_2, Mullite, Vycor, TaC, MgO, $MoSi_2$, Re, W, Mo, K-138A, SiC, Ta, Metamic LT-1, Ir, and AISI type 303 stainless steel with Mo coating. In addition, some tests were made at higher (2600 to 3600°F) temperatures. Results were appraised by both visual and metallographic examinations and by chemical analysis of the residual liquid metals. A small, simple method of testing materials in circulating liquids to obtain evidence of mass transfer is described. (auth)

7741 NAA-SR-2007

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

DEVELOPMENT AND PRODUCTION OF SRE FUEL ELEMENTS. J. J. Droher, W. J. Hallett, and H. Strahl. May 15, 1958. 53p. Contract AT(04-3)-49. $1.50 (OTS).

The requirements of the Sodium Reactor Experiment led to the development of a seven-rod fuel element, each rod containing slugs of slightly enriched metallic uranium bonded to a thin-wall stainless-steel tube with liquid sodium-potassium eutectic alloy. Apparatus

and procedures were developed and used for the fabrication of the fuel elements. Methods were devised for the inspection and testing of the component parts of the fuel elements and performance tests were made on prototype fuel elements. (auth)

7742 NMI-2031
Nuclear Metals, Inc., Cambridge, Mass.
FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report for February 1955. Mar. 4, 1955. Decl. Jan. 15, 1959. 12p. Contract AT(30-1)-1565. $3.30(ph), $2.40(mf) OTS.

The status of the work on Be, U, Th, and Zr metallurgy and corrosion studies is briefly presented. (For preceding period see NMI-2030.) (J.E.D.)

7743 NP-7155
Brussels. Centre d'Etude de l'Energie Nucléaire.
CONTRIBUTION A L'ETUDE DU POLISSAGE ELECTROLYTIQUE D'ALLIAGES D'URANIUM. (Contribution to the Study of Electrolytic Polishing of Uranium Alloys.) P. Van Asbroeck. Nov. 1956. 46p.

The electrolytic polishing of uranium-rich U–Nb and U–Zr alloys was investigated. The "Disa-Electropol" electrolytic polisher was used in the tests with the electrolyte being a mixture based on perchloric acid and alcohol. The effects of the polishing time and the potential used and the relationships between voltage and time and between current and voltage were determined for U–Zr alloys. The results showed that the electrolyte used gave relatively good results for U–Zr alloys. The same technique was applied to Nb–U alloys, but poor results were obtained. (J.S.R.)

7744 NP-7182
Illinois Inst. of Tech., Chicago. Armour Research Foundation.
RESEARCH AND DEVELOPMENT OF BRAZING ALLOYS FOR HIGH-TEMPERATURE APPLICATIONS AND RESISTANCE TO OXIDATION. Quarterly Progress Report No. 3 [for] October 1, 1958 to December 31, 1958. W. M. Lehrer and Harry Schwartzbart. Jan. 1959. 11p. ARF Project No. B-146. Contract AF33(616)-5654.

Apparatus was developed to measure remelt temperatures of the brazed joints simply and accurately. Some filler alloys containing phosphorus and indium demonstrated the feasibility of the vacuum process in raising the remelt temperature through volatilization of these elements. (For preceding period see NP-6968.) (auth)

7745 NP-7224
Massachusetts Inst. of Tech., Cambridge. Metals Processing Lab.
CHROMIUM COATINGS FROM LIQUID METAL SOLUTIONS. Peter Schwarzkopk, Ernst B. Weglein, and John Wulff. Dec. 1958. 29p. Contract Nonr-1841(30).

Chromium deposition on molybdenum from liquid tin–chromium baths is discussed. It was found that three types of solid-liquid interface are found to form by continuous cooling of a saturated solution of chromium in tin below the liquidus temperature: these are plane with cubic, with dendritic, and with pseudo-dendritic overgrowth. The third type of interface is particularly harmful to the protective nature of the coating deposited because of lack of thickness, density, and the entrapment of carrier metal. In order to avoid the formation of the pseudo-dendritic interface, further isothermal processing methods were investigated in detail. It was found possible to produce 0.001 in. coatings of chromium which are soft, dense, and relatively smooth by an "isothermal technique." Such coatings are too thin to offer protection to molybdenum above about 900°C in air. Since they exhibit solid solution alloy bonding to the substrate and can be laid down to duplicate the contour of machined, short-blasted, and otherwise roughened surfaces, the 0.001 in. chromium deposits offer some promise as a barrier substrate for spray coats. (auth)

7746 NP-7259
Bureau of Mines, Albany, Oreg.
THE MANUFACTURE OF ZIRCONIUM SPONGE. S. M. Shelton and E. Don Dilling. [1952]. 90p.

A general report on the production of zirconium sponge including the history, occurrence, mechanical properties, corrosion resistance, purification, and hafnium separation is presented. (J.E.D.)

7747 NP-7261
Columbia-National Corp., Cambridge, Mass.
TRANSCRIPTS OF SYMPOSIA ON ECONOMIC COMPARISON OF ZIRCONIUM AND STAINLESS STEEL IN NUCLEAR POWER REACTORS; NEW YORK, FEBRUARY 13, 1958; PITTSBURGH, MARCH 11, 1958. 107p.

The transcripts of the zirconium symposia sponsored by Columbia-National are presented. At each symposium Dr. Manson Benedict and J. W. Blanton presented papers on the procedures, assumptions, and results of studies on the economics of zirconium versus stainless steel as structural and cladding materials for five different types of power producing reactors and zirconium mill products, respectively. The New York symposium was attended chiefly by reactor personnel, while the Pittsburgh session was attended by zirconium producers. (W.D.M.)

7748 NP-7263
Narmco Inc., San Diego, Calif.
DEVELOPMENT OF EXO-REACTANT INORGANIC ADHESIVE SYSTEM. Quarterly Progress Report No. 2 Covering period October 1–December 31, 1958. Leonard Suffredini and Roger A. Long. Jan. 1, 1959. 37p. Contract NOas-58-857-c.

A wide variety of predominantly metal and metal oxide exothermic reaction mixtures were investigated to determine ignition temperatures; these are summarized. Empirical investigations on the control of exo-reactions were made on mixtures that showed promise as heat sources and have ignition temperatures below 1000°F. These tests included the effect of igniters and the use of duration extenders. Experiments were made to determine the quantity of various exo-reactant materials required to produce a temperature sufficient to heat through various stainless steel sheets to effect a silver braze bond. A boron and vanadium pentoxide mixture was used to exo-braze overlap tensile shear specimens. These were tested and gave shear strengths of approximately 25,000 psi at room temperature and 16,000 at 600°F. These results are equivalent to those obtained from conventionally brazed specimens. (auth)

7749 SCDC-717
[Sandia Corp., Albuquerque, N. Mex.]
SEALING OF SMALL HIGH PRESSURE CONTAINERS. R. L. Holloway. Jan. 14, 1958. 22p. Contract [AT (29-1)-789]. $4.80(ph), $2.70(mf) OTS.

The various methods in conventional use for joining covers to containers as required by the Thermal Battery Program conducted by Organization 1461-2 at Sandia Corporation are presented. Some attention has been shown to design problems relating to joint prepa-

ration compatible to the joining method used and the subsequent heat-sink fixturing and preparation for pressure testing as shown by photographic prints. Methods of joining discussed include: sealing by tin-lead solders (both low- and high-temperature applications); sealing by brazing (confined in this discussion to silver solder); heliarc, tungsten, and inert gas welding; and resistance welding using overlapping spot welds or seam roller weld. (auth)

7750 SCNC-277
Sylvania-Corning Nuclear Corp., Bayside, N. Y.
QUANTITATIVE DETERMINATION OF URANIUM LOADING OF ALUMINUM-CLAD FUEL PLATES BY X-RAY DENSITOMETRY. S. Priceman. Oct. 1958. 23p. Contract AT-30-1-GEN-366. $0.75(OTS).

A nondestructive method for determining U distribution in Al-clad fuel plates is described. The method is based on measurement of density variations in radiographic films. Its validity is demonstrated by comparison with a chemical method. (T.R.H.)

7751 WADC-TR-58-145
Dow Chemical Co., Midland, Mich.
TERTIARY CREEP STUDIES ON MAGNESIUM AND ITS ALLOYS. Period Covered: March 1957 to March 1958. J. C. Wijman. Apr. 1958. 25p. Project title: SOLID STATE RESEARCH AND PROPERTIES OF MATTER. Task title: MECHANISMS AND DEFORMATION BEHAVIOR OF SOLIDS. Contract AF33(616)-5057. (AD-155792).

Tertiary creep of sublimed magnesium was investigated, using creep curves, metallography, and specific volume measurements. A possible explanation for the accelerated stage of creep just before fracture is advanced. It is not believed that the metal itself weakens during the last stages of creep. Creep of pure magnesium in compression was investigated. Comparison with creep in tension indicated that the creep rate in compression is strongly orientation dependent. ZH11 alloy exhibits in the -0 temper at 700°F a very rapid rate of creep after an initial incubation period. The duration of this initial stage seems to be stress dependent. The initial accelerating stage of creep is believed to be caused by delayed yielding. (auth)

7752 WADC-TR-58-396
Stanford Research Inst., Menlo Park, Calif.
DEVELOPMENT OF PROCEDURES AND TECHNIQUES FOR PREPARING BONDED DOUBLE LAYER TANTALUM-COPPER COMPOSITE PLATES. [Period covered]: May 1957 to August 1958. R. C. Bertossa and S. Rau. Aug. 19, 1958. 113p. Project title: ATLAS MATERIALS. Task title: GRAPHITE-BASED MATERIALS FOR HIGH TEMPERATURE APPLICATIONS. Contract AF33(616)-5215. (AD-203901).

The purpose of this project was to develop a process for bonding tantalum sheet to OFHC copper. This was successfully accomplished both by casting molten copper directly into an annealed tantalum cone under controlled vacuum-inert gas atmospheres, and by using intermediate brazing alloys to produce high integrity, vacuum bonded joints between OFHC copper and annealed tantalum. Metallurgical and microhardness evaluations reveal that sound, continuous bonds can be effected, with ductile interfaces, in joining OFHC copper to annealed tantalum by vacuum-inert gas techniques. Physical tests on brazed copper-tantalum composite plates show excellent bond strengths under multi-axial stresses encountered in 180° flat bends and in cold forming of flat composite plate into nose-cone shapes. Elevated temperature tests on copper-tantalum clad nose-cones, both uncoated and metal or ceramic coated on the exposed tantalum surfaces, exhibited the ability of selected brazing alloys to maintain intimate contact between the copper and tantalum at temperatures up to the melting point of copper. The high thermal conductivity of the copper layer enabled it to absorb sufficient heat from the tantalum surface to allow the tantalum cone shell to contain the molten copper as long as two minutes at temperatures above 2000°C (measured optically on the exposed tantalum). (auth)

7753 WAL-401-258
New York Univ., New York. Coll. of Engineering.
THE INFLUENCE OF PRIOR PLASTIC STRAIN AND INTERSTITIAL CONTENT OF THE AGING BEHAVIOR AND MECHANICAL PROPERTIES OF ALPHA-BETA TITANIUM ALLOYS. Final Report. R. F. Bunshah. Aug. 1958. 103p. DA Project No. 593-08-021. Contract DA-30-069-505-ORD-1779.

A hardness survey supplemented by selected tensile data, electrical resistivity measurements and microstructural examination were the tools to study the effect of prior plastic strain on the aging behavior of Ti-8Mn and Ti-16V base alloys at various interstitial levels. Prior plastic strain accelerates the initial rate of aging and of overaging in both sets of alloys. The influence of interstitials in both sets of alloys is to increase the maximum hardness produced on aging. In the Ti-8Mn base alloys, the addition of 0.2% O_2 to the base composition delayed the overaging process. 0.1% C addition acted the same way but to a lesser degree. The addition of 0.015% H_2 and 0.025% H_2 increased the initial aging rate and the overaging rate. No strain aging behavior was observed. (auth)

7754 WAL-TR-401/266
Watertown Arsenal Lab., Mass.
ORIENTATION SENSITIVITY OF ALPHA TITANIUM TO ELECTRO STAINING. Ralph H. Hiltz, Jr. Feb. 1959. 11p. Project title: MATERIAL FOR LIGHT-WEIGHT CONSTRUCTION. (AD-210867).

Large grain specimens of iodide titanium prepared metallographically were stain etched. Orientations of grains showing an abnormal response to stain etching were determined by back reflection x-ray techniques. X-ray results showed that alpha titanium grains, oriented such that their basal plane was parallel to the polished surface, have a slower reactivity to stain etching than any other orientation. Grains oriented such that their basal planes made small angles with the polished surface exhibited reactions rates between that of the true basal orientation and the normal rate. As the angle increases, the reactivity increases up to a maximum angle of approximately 14°. Basal planes making an angle with the surface of greater than approximately 14° show normal reactivity to stain etching. These data, plus work on polycrystallization specimens, indicate that the oxidation rate of titanium might be reduced by correct alignment of crystal planes. (auth)

7755 WAPD-BT-10
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
BETTIS TECHNICAL REVIEW. REACTOR METALLURGY. Oct. 1958. 120p. Contract AT-11-1-GEN-14 and Appropriate NObs-Contracts. $2.75(OTS).

Eleven review papers are presented on some metallurgy activities at Bettis Plant in connection with reactor projects. Separate abstracts have been prepared for each paper. (T.R.H.)

7756 WAPD-BT-10(p.1-8)
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
THE EXTRUSION PROCESS FOR CONVERTING ZIRCALOY-2 INGOTS TO STRIP. W. H. Friske and E. L. Richards. p.1-8 [of] BETTIS TECHNICAL REVIEW. REACTOR METALLURGY. 8p.

The feasibility of extruding Zircaloy-2 ingots directly to strip was investigated as a possible solution to the stringer corrosion problem. Extruded slabs from ten ingots were rolled to strip, five by a continuous-mill process, and five by a hand-mill process. Yield and conversion analyses indicate that the direct extrusion process is competitive with the more conventional conversion procedures; there were no apparent differences in yield, metallurgical properties, or corrosion properties between strip produced by the hand-mill process and that produced by the continuous-mill process. Neither resulted in decrease or elimination of stringer corrosion. (auth)

7757 WAPD-BT-10(p.9-13)
Illinois Inst. of Tech., Chicago. Armour Research Foundation.
DEVELOPMENT OF BRAZING MATERIALS FOR JOINING ZIRCALOY. R. E. Droegkamp. p.9-13 [of] BETTIS TECHNICAL REVIEW. REACTOR METALLURGY. 5p. For [Westinghouse Electric Corp.] Bettis Plant. Subcontract 73-(14-401).

Four alloys were successfully used to braze Zircaloy samples, and an attempt was made to select, through testing, the one most suited for reactor applications. Investigations were made to determine joint properties, corrosion resistance, and possible radiation damage. A Zircaloy-2–4 wt. % Be alloy exhibited the best flow properties, strength, and corrosion resistance. Kanigen alloy has the advantage that it can be plated; and a Cu–20 wt. % Pd–3 wt. % In alloy was the only one which could be fabricated. (auth)

7758 WAPD-BT-10(p.14-22)
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
ROLL-BONDING HAFNIUM, TITANIUM, AND ZIRCALOY-2. E. S. Byron and S. W. Porembka. p.14-22 [of] BETTIS TECHNICAL REVIEW. REACTOR METALLURGY. 9p.

Roll-bonding was investigated as a possible method of cladding certain control rod materials. Samples of hafnium, titanium, and Zircaloy-2 were roll-bonded in various combinations and at various temperatures and percent reductions. Hafnium–titanium bonds were the only ones that failed consistently during bend testing, while the Zircaloy–titanium bonds displayed good corrosion resistance, ductility, and shear strength. (auth)

7759 WAPD-BT-10(p.23-30)
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
RELATIONSHIP OF COOLING RATE TO THE CORROSION RESISTANCE OF ZIRCALOY-2. L. S. Rubenstein, J. G. Goodwin, and F. L. Shubert. p.23-30 [of] BETTIS TECHNICAL REVIEW. REACTOR METALLURGY. 8p.

A program was conducted to develop a post-fabrication heat treatment which would improve the corrosion resistance of Zircaloy-2 and Zircaloy-3. Samples representing vacuum- and inert-atmosphere-melted materials were tested after receiving a variety of heat treatments. Results indicate that it is advisable to follow any heat treatment in the beta or alpha-plus-beta phase region with a rapid cooling rate of greater than 90°F/min. (auth)

7760 WAPD-BT-10(p.31-48)
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
HYDROGEN PERMEATION OF ZIRCALOY-2 CORROSION FILMS. R. F. Boyle and T. J. Kisiel. p.31-48 [of] BETTIS TECHNICAL REVIEW. REACTOR METALLURGY. 18p.

Hydriding failure of fuel rod cladding in an in-pile test led to a detailed investigation of hydrogen permeation of Zircaloy-2. Out-of-pile tests were run to observe the mechanism of hydriding through corrosion films, to determine the effect of high H_2 pressure during normal 750°F-steam corrosion, and to attempt to simulate the in-pile failures. Although the present results are compatible with the Lustman-Kisiel model for hydriding failure, substantial work must be done to check postulates in the model regarding the nature, location, and extent of hydrogen enrichment of the steam atmosphere inside a defected fuel rod. (auth)

7761 WAPD-BT-10(p.49-56)
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
THE TORSIONAL PROPERTIES OF ZIRCALOY-2 AND ZIRCALOY-3. R. E. Johnson. p.49-56 [of] BETTIS TECHNICAL REVIEW. REACTOR METALLURGY. 8p.

Torsional tests were performed on Zircaloy-2 and -3 in the hot-rolled and base-annealed conditions. Results given include Poisson's ratio, shear moduli, and torsional and tensile yield strengths. (T.R.H.)

7762 WAPD-BT-10(p.57-72)
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
PLATE-TYPE, UO_2-BEARING FUEL ELEMENTS FOR THE PWR CORE 2 BLANKET. E. F. Losco, R. L. Fischer, N. T. Saunders, and R. A. Wolfe. p.57-72 [of] BETTIS TECHNICAL REVIEW. REACTOR METALLURGY. 16p.

Compartmented, plate-type UO_2-bearing fuel elements were fabricated by eutectic diffusion-bonding of Zircaloy-2 cladding components. Out-of-pile tests on these samples included internal pressurization, corrosion resistance, intentional defection, and thermal cycling. The performance of the iron- and copper-bonded samples indicated strength and ductility to be good and the process appears to offer design flexibility and the potential of relatively low manufacturing cost. (auth)

7763 WAPD-BT-10(p.73-92)
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
DEFLECTION AND RUPTURE OF ZIRCALOY-2 PLATE COMPARTMENTS UNDER INTERNAL PRESSURE. R. D. Leggett. p.73-92 [of] BETTIS TECHNICAL REVIEW. REACTOR METALLURGY. 20p.

Excessive internal pressure causes deformation of compartments in a plate-type fuel element containing unbonded but compartmented ceramic fuel. Bettis Plant embarked upon a test program to measure the extent of this deformation as a function of internal pressure because it is a potential cause of cladding swelling and failure. Results of tests at room temperature and 600°F correlate well with elastic theory, deviating only slightly for the smallest compartments tested. (auth)

7764 WAPD-BT-10(p.93-5)
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
OXIDATION OF UO_2 IN WATER CONTAINING OXYGEN. S. Aronson. p.93-5 [of] BETTIS TECHNICAL REVIEW. REACTOR METALLURGY. 3p.

Oxidation of UO_2 in air or gaseous oxygen does not proceed beyond U_3O_8. The experiments described here

involved the oxidation of UO_2 powder in 87 to 177°C oxygenated water. A new phase, previously described in the literature and identified as $UO_3 \cdot 0.8\ H_2O$, was produced by a completely different mechanism from that of gaseous oxidation. (auth)

7765 WAPD-BT-10(p.96-100)
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
DENSITIES OF URANIUM OXIDE IN THE REGION UO_2–U_4O_9. J. C. Clayton and S. Aronson. p.96-100 [of] BETTIS TECHNICAL REVIEW. REACTOR METALLURGY. 5p.

Mallinckrodt PWR Core 1 UO_2 powder samples were oxidized to various compositions up to U_4O_9 and were homogenized at temperatures of 200, 350, and 700°C. X-ray diffraction and density measurements were made. The U_4O_9 phase did not appear in samples of composition lower than $UO_{2.10}$; the density increased linearly with degree of oxidation. (auth)

7766 WAPD-BT-10(p.101-11)
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
CALORIMETRIC DETERMINATION OF ORDERING IN THE U–Mo SYSTEM. R. F. Boyle and E. K. Halteman. p.101-11 [of] BETTIS TECHNICAL REVIEW. REACTOR METALLURGY. 11p.

Calorimetric and x-ray spectrometer measurements were used to verify the presence of an order-disorder reaction in the U–Mo system. The results are in good agreement with order-disorder theory. A slight readjustment of previously accepted phase boundaries was indicated as necessary, however. (auth)

7767 WAPD-CTA(MEA)-1795
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
EDDY CURRENT INSPECTION OF BOILER TUBES AT SHIPPINGPORT, FEBRUARY 8 THRU 17, 1958. G. R. McIndoe. Apr. 24, 1958. 11p. $3.30(ph OTS); $2.40(mf OTS).

The Probolog traces shown are the result of an eddy current inspection performed on the tubes in the PWR B-boiler at the Shippingport Site. Two tubes were found to be leaking. Metallographic examination of the removed sections of tubes disclosed radial cracks originating on the outer surface of the tube wall and extending mainly along the longitudinal axis of the tube. (W.L.H.)

7768 WCAP-1030
Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
THERMOELECTRIC NUCLEAR FUEL ELEMENTS. Quarterly Progress Report No. 1. F. L. Carter, J. C. Danko, H. M. Ferrari, G. R. Kilp, and G. L. Thomas. Nov. 15, 1958. 74p. Contract AT(30-3)-500.

A feasibility study on the application of mixed-valence thermoelectric materials for new reactor concepts was initiated. Preliminary thermoelectric nuclear fuel element design considerations were formulated to provide guidance in the selection of materials, shapes, dimensions, and fabrication procedures. Studies involving the preparation of materials having optimum thermoelectric properties were performed on $Li_xCu_{1-x}O$, $Li_xNi_{1-x}O$, cerium compounds, and uranium dioxide. The most promising material to date is $Li_{.05}Ni_{.95}O$, although some of the other compounds have greater potential promise. Mixed-valence compounds of cerium, including the oxides, sulfides, selenides, tellurides, and silicides, were or will be prepared. Urania mixed-valence materials with additives of Na^+, Ca^{2+}, Y^{3+}, Tl^{3+}, Ta^{5+}, and W^{4+} were successfully prepared. Apparatus was designed and constructed to measure thermoelectric properties at elevated temperatures in an oxidizing or inert atmosphere or vacuum. Values for the Seebeck coefficient, electrical resistivity, and thermal conductivity were obtained for $Li_xNi_{1-x}O$ material as a function of temperature and composition. Room temperature measurements of the Seebeck coefficient and electrical resistivity were obtained for cerium sulfides, cerium selenides, and urania materials. The physical and chemical properties of $Li_xCu_{1-x}O$ and $Li_xNi_{1-x}O$ thermoelectric materials were investigated. Apparatus was designed and constructed for measuring thermal diffusion, expansion coefficients, and compressive strength. Other studies on bonding characteristics, corrosion resistance in high temperature pressurized water, and thermal stability were performed. Thermal stability studies on the mixed-valence compounds indicate that $Li_xNi_{1-x}O$ materials are very unstable in reducing or inert atmospheres. Because of this instability, bonding of the $Li_xNi_{1-x}O$ compounds to stainless steel and copper was unsuccessful. Corrosion studies on thermoelectric materials in pressurized water revealed, for short time tests, that $Li_xNi_{1-x}O$ exhibits very good corrosion resistance whereas the Li_xCu_{1-x} is only fair. Fabrication studies of thermoelectric materials were limited to $Li_{.05}Ni_{.95}O$. The effects of compacting pressure, sintering temperatures, sintering times, and binders on density were evaluated. Fabrication of $Li_{.05}Ni_{.95}O$ thermoelectric material by flame spraying was successful in the preliminary test. Deposits of 25 mils were achieved. Apparatus for measuring the effect of radiation on the thermoelectric properties of mixed-valence thermoelectric materials was designed and is being constructed: one to make pre- and post-neutron irradiation studies, and the second to study the changes in properties as a function of electron bombardment. To obtain an estimate of electron irradiation damage rate and length of bombardment time necessary to obtain significant changes in thermoelectric properties, a sample of $Li_xNi_{1-x}O$ is being irradiated for studies with the available measuring devices. (auth)

7769 WCAP-1095
Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
THERMOELECTRIC NUCLEAR FUEL ELEMENT. Quarterly Progress Report No. 2. F. L. Carter, J. C. Danko, H. M. Ferrari, A. E. Fein, W. D. Johnston, G. R. Kilp, and G. L. Thomas. Feb. 13, 1959. 72p. Contract AT(30-3)-500. $12.30(ph), $4.50(mf) OTS.

A new class of potential thermoelectric materials, the perovskites, has been included under material investigation. Work has been initiated on $La_xBa_{1-x}TiO_3$, $Y_xCa_{1-x}TiO_3$, and $Al_xMg_{1-x}TiO_3$, all of which are n-type materials. Work has also been begun on a p-type perovskite, $Ca_xY_{1-x}UO_3$. Studies were continued on CeS_x and $CeSe_x$ type materials. Compounds of the composition $Ce(S_{.5}Se_{.5})_x$, where $1.33 \leq X \leq 1.50$, were prepared. Thermoelectric property measurements on $Li_x(Mg_yNi_{1-y})_{1-x}O$ materials revealed the electrical resistivities of these materials to be too high to make them practical. Some room-temperature measurements were made on the CeS_x and $Ce(S,Se)_x$ materials. The thermoelectric measurements on $La_xBa_{1-x}TiO_3$ show that an efficiency of over 2% can be obtained at 400°C, and extrapolated data indicate that 6% should be possible at 1000°C. The use of UO_2 as a thermoelectric material does not appear too attractive. Bonding studies were

continued on $Li_xNi_{1-x}O$ type materials. Experiments on $Li_xNi_{1-x}O$-ceramic couples indicated that ZrO_2, Al_2O_3, and MgO showed no reaction up to 1100°C, but SiO_2 forms a low-melting phase below this temperature. The schematic and wiring diagrams for the hot cell and Van de Graaff apparatuses to be used for irradiation measurements are presented as well as photos of some of the completed assemblies. (For preceding period see WCAP-1030.) (W.L.H.)

7770 YAEC-68

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

CORROSION OF AISI TYPE 304 STAINLESS STEEL IN HIGH TEMPERATURE BORATED WATER. A. Krieg and S. J. Cytron. Dec. 1958. 60p. For Yankee Atomic Electric Co. Contract AT(30-3)-222, Subcontract No. 1. $9.30(ph), $3.60(mf) OTS.

The corrosion of type 304 stainless steel in water containing boric acid at 600°F and 2000 psig and at a flow velocity of seven feet per second was investigated as a function of boron concentration and of alkalinity. At a boron concentration of 39 ppm and at a pH value of 10, controlled with lithium hydroxide, no trend of corrosive attack with time was found after the first two days. At a concentration of 41 ppm boron with no pH control (pH = 6.9), a regression type equation of the form Y = A + B log (t), was found to express the relationship between corrosive attack and exposure time. A similar relationship was found at 1600 ppm boron with the pH value maintained at 10 using lithium hydroxide. No evidence of microstructural attack was observed on coupon specimens under any of the conditions tested. The effects of surface finish and of position were studied. The effect of orientation of the rolling direction of coupon specimens with respect to the direction of fluid flow was also investigated. (auth)

7771 CEA-tr-A-162

ALUMINIUM-FER-NICKEL. (Aluminum–Iron–Nickel.) H. Hanemann and A. Schrader. Translated into French by A. Hauptman, P. Monnard, and A. Roux from p.105-9 [of] Ternäre Legierungen des Aluminiums, 1952. 15p.

The aluminum-rich part of the aluminum–iron–nickel system is reviewed, and the phases and crystal structure are discussed. (J.S.R.)

7772 CEA-tr-A252

MESURE, SANS ELECTRODE, DE LA RESISTIVITE ELECTRIQUE DES METAUX ET ALLIAGES À HAUTE TEMPERATURE. (Measurement, without Electrodes, of the Electrical Resistivity of Metals and Alloys at High Temperatures.) H. Speidel. Translated into French from These D 93, T. H. Stuttgart, 1940. 25p.

The methods of measuring, without electrode, the electric conductivity of metals and alloys at high temperatures are discussed, and the apparatus used in the transformer method and the rotating field method are described. The measurement system of the rotating field device and the corrections to be made to the results are considered. The electric conductivity of manganese was measured from 20°C up to its fusion point. (J.S.R.)

7773 CEA-tr-A381

OBTENTION PAR VOIE CHIMIQUE D'UNE COUCHE PROTECTRICE EPAISSE DE FLUORURE DE MAGNESIUM SUR DES ALLIAGES DE MAGNESIUM. (Chemical Method for Obtaining a Thick Protective Layer of Magnesium Fluoride on Magnesium Alloys.) M. Staesche. Translated into French by B. Moreau from Arch. Metallk. 3, 99-103(1948). 12p.

A survey is made of the different protective coatings used on magnesium alloys, such as lacquers, impregnation by a bichromate–nitric acid mixture, magnesium oxide layer, magnesium mineral layer, and organic compounds of magnesium. The method to be used for the production of thick adherent layers of magnesium hydroxide on magnesium was investigated. The properties of the hydroxide coating were examined. A study was made to determine the best method of converting hydroxide to the fluoride, and the properties of the fluoride layer were investigated. (J.S.R.)

7774 CEA-tr-A400

ALUMINIUM–FER–SILICIUM. (Aluminum–Iron–Silicon.) H. Hanemann and A. Schrader. Translated into French by A. Hauptmann and P. Monnard from p.109-15, Vol. III, Pt. 2 of Atlas Metallographicus, Verlage Stahleisen, Duesseldorf, 1952. 28p.

The crystalline structure and phases of the aluminum-rich portion of the aluminum–iron–silicon system are described. Three phases, $Al_{12}Fe_3Si$, $Al_9Fe_2Si_2$, and Al_4FeSi_2, are discussed in detail. The structure of commercially pure aluminum is also discussed. (J.S.R.)

7775 CEA-tr-R-283

PELLICULES OXYDÉES SUR LE MAGNESIUM. (Oxidized Films on Magnesium.) N. A. Chichakov and N. K. Androutchenko. Translated into French from Zhur. Fiz. Khim. 30, 1966-74(1956). 14p.

The formation of oxide films on magnesium was studied. It was established the thickness of the layer formed during the first stage of oxidation (the rapid stage) will reach a value of approximately 70 A, if the calculation is made on the visible surface of the layer. The velocity of the oxygen influx with respect to the metal appears to have only an insignificant effect on this value. The oxidation process of magnesium is affected by lubricant grease. A study of the electron diffraction diagrams shows that the natural protective oxide layer on the magnesium is formed of magnesium oxide crystals oriented in a definite manner with respect to the crystals of metallic magnesium. The hydroxide film formed by hot alkaline solutions also has crystals oriented with respect to the metallic crystals. The solid bond between these films and the metal and the resistance to corrosion can be explained by this oriented growth. (tr-auth)

7776 CEA-tr-R-308

APPLICATION DE LA MÉTHODE DE MICRO-DURETÉ À L'ÉTUDE DU DIAGRAMME D'ETAT. (Application of the Microhardness Method to the Study of the Phase Diagram.) V. M. Glazov, G. A. Korol'kov, and Yu. D. Chistyakov (Y. D. Tchistiakov). Translated into French from Izvest. Akad. Nauk S.S.S.R., Otdel. Tech. Nauk, No. 12, 131-5(1955). 13p.

The curves of limited solubility were constructed by the microhardness method for cadmium–tin and cadmium–bismuth alloys. The dependence of the microhardness on the composition of the alloys was shown in aluminum–silicon and aluminum–zinc systems. The transition between the horizontal part and the vertical part of the microhardness curve was studied as a function of the composition in the two-phase zone of the phase diagram of aluminum–silicon systems. (J.S.R.)

7777 CEA-tr-R-492

ESSAI DE CORROSION GAZEUSE DES ÉPROUVETTES SOUS EFFORT DE TRACTION. (Test of the Gaseous Corrosion of Samples Under Stress.) M. Ya. Lvovskii (M. Ia. Lvovsky) and G. E. Moskalenko. Translated by B. de Trezvinsky into the French from Zavodskaya Lab. 23, 1374-6(1957). 6p.

The oxidation of nickel alloys under stress was tested for 100 hr at 1000 to 1200°C on samples of various sizes. Punching of the samples allowed the determination of the effect of a localized deformation. The results showed that with an increase of the stress, the depth of penetration of the oxidation increases. A direct relationship between the accelerated oxidation and the deformation was established. The deformation of the alloy under stress at different temperatures was studied. (J.S.R.)

7778 CEA-tr-R-569

DECAPAGE DES ACIERS INOXYDABLES. (Etching of Stainless Steels.) A. A. Babakov, A. A. Sabinine, and I. P. Sinitsyne. Translated into French by B. de Trezvinsky from Stal' 17, 631-4(1957). 16p.

The utilization of thermal treatment combined with a preliminary saline coating (by a saturated solution of NaCl or NaCl and $NaNO_3$) on sheets of stainless steel with a high chromium content facilitates and reduces the cost of the removal of the calamine during the subsequent etching. (tr-auth)

7779 CEA-tr-R-573

INFLUENCE DES IMPURETES SUR LES PROPRIETES DES ALLIAGES REFRACTAIRES A BASE DE Ni–Cr. (Effect of Impurities on the Properties of Refractory Alloys with Ni–Cr Base.) M. V. Pridantzev and G. V. Estouline. Translated into French by [B.] de Trezvinsky from Stal 17, 635-9(1957). 11p.

The effect of impurities on the mechanical properties of chromium–nickel alloys was investigated. The results showed that the most harmful are lead, antimony, and other elements having a low melting point and an insignificant solubility in the solid solution. Impurities of sulfur, carbon, silicon, and manganese above a certain minimum limit have a detrimental effect on the plastic deformation properties of chromium–nickel alloys. (J.S.R.)

7780 CEA-tr-X-115

OXYDATION A HAUTE TEMPERATURE DE METAUX ET D'ALLIAGES. (High Temperature Oxidation of Metals and Alloys.) Per Kofstad. Translated into French from Tek. Ukeblad 104, 249-54(1957). 18p.

A theoretical study is made of the oxidation mechanism of alloys. The Wagner theory of oxidation is applied in a modified form to the investigation of the effect of low quantities of impurities. For alloys containing large quantities of alloying constituent, very little is understood of the oxidation mechanism. Chromium–nickel alloys and stainless steel are used as examples in the discussion of oxidation mechanisms. Internal oxidation is also considered. 27 references. (J.S.R.)

7781

THERMODYNAMIC ANALYSIS OF BINARY LIQUID ALLOYS OF GROUP II B METALS. I. THE SYSTEMS ZINC–CADMIUM, ZINC–GALLIUM, ZINC–INDIUM AND ZINC–TIN. O. J. Kleppa (Technical Univ. of Norway, Trondheim). Acta Met. 6, 225-32(1958) Apr.

Some new information is presented on the heat of mixing in the liquid alloys of zinc with cadmium, indium, and gallium. The results are discussed along with those obtained in earlier work on zinc–tin. In the systems considered a correlation is found between energetic asymmetry and the difference in valence between the two components. Partial molal heat contents of zinc derived from the present work are compared with corresponding data on the excess free energy available in the literature. The evaluated excess entropies are largest for zinc–tin, of similar and intermediate magnitude for zinc–indium and zinc–gallium, and quite small for zinc–cadmium. An interpretation of the observations in terms of the electronic heat capacities is suggested. (auth)

7782

THERMODYNAMIC ANALYSIS OF BINARY LIQUID ALLOYS OF GROUP II B METALS. II. THE ALLOYS OF CADMIUM WITH GALLIUM, INDIUM, TIN, THALLIUM, LEAD AND BISMUTH. O. J. Kleppa (Univ. of Chicago). Acta Met. 6, 233-42(1958) Apr.

Some new information is presented on the integral heat of mixing in the liquid alloys of cadmium with gallium, indium, thallium, and bismuth. The results are discussed along with corresponding data reported earlier for the cadmium–tin and cadmium–lead systems. The relative partial molal heat contents of cadmium are derived from the integral heat data. The corresponding excess entropies are evaluated from these quantities and the equivalent excess free energies available from e.m.f. studies and/or calculated from the appropriate phase diagrams. The excess entropies correlate roughly with the valence difference of the two components. The excess entropies of cadmium are compared with the entropies of zinc in equivalent alloys involving this metal. This comparison seems to confirm that the valence difference of the two components is of particular importance in determining the magnitude of the excess entropy. (auth)

7783

INVESTIGATION OF THE $K\beta_5$-BAND AND K-ABSORPTION EDGE IN Ni METAL BELOW AND ABOVE THE CURIE POINT. V. A. Kazantsev (Shevchenko Lugansk State Pedagogical Univ.). Doklady Akad. Nauk S.S.S.R. 123, 667-70(1958) Dec. 1. (In Russian)

The dependence of x-ray spectra on the magnetic states of pure elements (Co, Fe, Gd, and Ni) was investigated and the results are given for K-absorption and K_{β_5} emission for pure nickel (99.99%) through the Curie point transition. (R.V.J.)

7784

THE SPECTROGRAPHIC ANALYSIS OF ZIRCALOYS. J. Allen Wheat (E. I. du Pont de Nemours & Co., Aiken, S. C.). Appl. Spectroscopy 12, No. 5, 152-3(1958).

Tin, iron, chromium and nickel can be determined as alloying constituents in Zircaloys by the point-to-plane spark method of spectrographic analysis. Under appropriate conditions this method can be applied to the analysis of rolled sheet and thin-walled tubing as well as to the analysis of massive blocks. Coefficients of variation are four per cent for tin, chromium, and nickel, and six per cent for iron. (auth)

7785

ELECTRON MICROSCOPIC STUDY OF PRECIPITATION IN THE Al–Zn–Mg ALLOY WITH 7% Zn AND 3% Mg (AZ7G3). Bernard Genty, René Graf, and

Gabriel Lenoir. Compt. rend. 247, 2126-9(1958) Dec. 10. (In French)

The Al–Zn–Mg alloy containing 7% Zn and 3% Mg was compared microscopically with the alloy containing 9% Zn and 1% Mg. The precipitates in the 7% Zn alloy are smaller and their shapes are less sharply differentiated. The largest precipitates are developed on the grain boundaries, which are bordered by an impoverished region. (J.S.R.)

7786

ELECTRON MICROGRAPHY AND MICRODIFFRACTION OF THIN SECTIONS OF URANIUM. Adrien Saulnier and Paul Mirand. Compt. rend. 247, 2351-4(1958) Dec. 22. (In French)

A simple technique permits the preparation from massive sample of uranium sections sufficiently thin to be observed in an electron microscope. Micrographs and microdiffraction plates show that these sections are composed primarily of the metal and are covered by only a thin film of oxide. (tr-auth)

7787

EFFECT OF IMPURITIES ON THE ELIMINATION OF RETICULAR FAULTS DURING LOW TEMPERATURE ANNEALING OF COLD WORKED ZONE MELTED ALUMINUM. Omourtague Dimitrov. Compt. rend. 247, 2355-8(1958) Dec. 22. (In French)

It is shown that the decrease of the resistivity preceding recrystallization, during low-temperature annealing of zone-melted aluminum cold-worked at the temperature of liquid nitrogen, is caused by faults whose effect on the mechanical properties is very weak. The elimination of the faults, at a velocity independent of the presence of small quantities of impurities, follows the same law and has the same activation energy as the elimination of lacunes maintained by the tempering of aluminum. The recrystallization is extremely sensitive to very low quantities of impurities. (tr-auth)

7788

PREPARATION OF MANGANESE BY METALLOTHERMAL REACTION UNDER REDUCED PRESSURE. Etienne Bonnier and Regis Caboz. Compt. rend. 247, 2358-60(1958) Dec. 22. (In French)

The free enthalpy diagram of the Fe–Mn–Si system at 1600°K permits the specification of the conditions for obtaining, in the vapor state, pure manganese by the reaction, under reduced pressure, between iron or ferromanganese and silico-manganese. The condensed manganese obtained contains less than 0.2% iron, 0.1% silicon, and 0.06% carbon, and under certain conditions less than 0.007% iron and 0.005% silicon. (tr-auth)

7789

THE REACTION OF NITROGEN WITH LITHIUM AT ORDINARY TEMPERATURE AND THE ROLE OF WATER VAPOR IN THIS REACTION. Jean Besson and Werner Müller. Compt. rend. 247, 2370-2(1958) Dec. 22. (In French)

The black layer which is formed in air on lithium is not the nitride, but the hydroxide caused by atmospheric humidity. At room temperature, dry nitrogen has no effect. The fixation of nitrogen is produced if the metal is, or has been, in contact for a sufficient time with water vapor, even after a second melting in vacuum. The fixation is delayed or stopped by too thick a layer of hydroxide. (tr-auth)

7790

PURIFICATION OF ZIRCONIUM BY THE VERTICAL ZONE MELTING METHOD. Jean-Paul Langeron, Pierre Lehr, et al. Compt. rend 248, 35-40(1959) Jan. 5. (In French)

The method of zone melting has permitted the preparation of zirconium containing 8×10^{-6} iron and 1×10^{-6} nickel, which corresponds to purification factors of 100 and 20, respectively. This high degree of purification is caused by the superposition of the zone melting mechanism and of fusion treatment under vacuum. The stability of the vertical melted zone was considerably improved in the case of zirconium by moving the zone displacement from the top to the bottom. (tr-auth)

7791

NEW EXPERIMENTAL RESULTS ON THE CONDUCTIVITY OF VERY THIN LAYERS OF NICKEL. Antoine Colombani and Guy Goureaux. Compt. rend. 248, 380-3 (1959) Jan. 19. (In French)

It was previously shown that after a prolonged annealing at 420°C, the resistivity of films varied as a function of temperature for thicknesses greater than 35 A (Compt. rend. 247, 189(1958)). A further investigation was made with very thin samples by characterizing them by the value of their surface resistance. The curves obtained show a negative temperature coefficient and a point of inflection. The variation of the temperature coefficient as a function of the temperature and the variation for a wide range of thicknesses were shown. The results on the Hall effect of very thin films with a negative temperature coefficient indicate that this effect is completely positive or presents an inversion phenomena in a field which is weaker when the thickness is a minimum. (J.S.R.)

7792

ELECTRON MICROSCOPIC OBSERVATION OF THE PRECIPITATES ON THE MULTIPLICATING DISLOCATION SOURCES IN AN ALUMINUM–COPPER ALLOY WITH 4% AGING. Pierre A. Jacquet and Edmond Mencarelli. Compt. rend. 248, 405-8(1959) Jan. 19. (In French)

Electron micrography on alumina replicas confirms that the domains of heterogeneities produced at the beginning of the annealing of the tempered solid solution are connected with the dislocations in the lattice. The characteristics of the precipitates on the multiplying sources are described. (tr-auth)

7793

THE EFFECTS ON THE RESISTIVITY OF PROTON DIFFUSION IN STEEL AFTER CHARGING IN ACID MEDIA AND PLASTIC DEFORMATION. Eugene Herzog and Michel Hugo. Compt. rend. 248, 408-10 (1959) Jan. 19. (In French)

The effects of proton diffusion in steel were studied by measuring the variation of the electric resistivity during the hydrogen penetration. The hydrogen was introduced into the samples by cathode charging or by immersion in a solution saturated with H_2S. A definite increase of the samples partially charged with hydrogen was proved if the velocity of charging was great enough. When saturation is attained, the phenomenon varies according to the mode of introduction of hydrogen. In the case where the sample was charged in the presence of H_2S, the effects are permanent and are shown by a deterioration of the sample. (J.S.R.)

7794

MAGNETIC PROPERTIES OF VERY THIN LAYERS OF NICKEL. Guy Goureaux and Antoine Colombani. Compt. rend. 248, 543-6(1959) Jan. 26. (In French)

The curves of the Hall effect for various thicknesses of nickel films indicate inversion in fields all the weaker as the thickness is a minimum. The magnetization constant determined as a function of film thickness has a maximum in the neighborhood of 100 A and the field constant has a minimum. The contribution of the conduction electrons of the 4s band and the holes of the 3d band to the conductivity is discussed. (J.S.R.)

7795

COMPARISON BETWEEN THE DAMPING OF ELECTROLYTIC IRON AND ZONE MELTED IRON. Francis Dabosi, Bernard Migaud, and Jean Talbot. Compt. rend. 248, 553-5(1959) Jan. 26. (In French)

The variation of the damping with the temperature and with the amplitude of the torsion angle was studied in electrolytic and zone-melted iron by measurements of the internal friction. The results showed that in the same experimental conditions, the zone-melted iron had a higher damping than that of electrolytic iron. The variation of the damping with the amplitude of the torsion angle is greater in the zone melted iron than in the electrolytic iron. (J.S.R.)

7796

EFFECTS OF THE THERMAL TREATMENT CONDITIONS ON THE INCREASED GROWTH OF SOFT IRON. Pierre Coulomb. Compt. rend. 248, 682-5(1959) Feb. 2. (In French)

The increased growth of soft iron is caused by the elimination of impurities by hydrogen. Its appearance depends on the chemical composition and the rolling conditions, but also on the aging at room temperature before annealing and on the conditions of metal–gas exchange (thickness of the sheet and temperature). (tr-auth)

7797

VARIATION OF INTERATOMIC BOND FORCES IN A SINGLE PHASE SOLID NICKEL–ALUMINIUM SOLUTION. G. V. Kurdyumov, V. K. Kritskaya, P. A. Lataiko, and Yu. A. Osipyan. Doklady Akad. Nauk S.S.S.R. 124, 76-8(1959) Jan. 1. (In Russian)

Studies were made of the Young's modulus changes in Ni–Al (8.3 at. % Al) annealed at 1150° for 100 hours. The course of modulus changes after 2 hours at 100 to 1000°C is shown diagrammatically. It was found that a high modulus (B) state in annealed alloy appears as the transition takes place in rapid cooling from 300° to room temperature; no changes were observed in the state A alloy heated to 300°. The changes take place only during rapid cooling. Microstructures of specimens slowly cooled from 1000° and water cooled from 300° are shown. (R.V.J.)

7798

TERNARY SEMICONDUCTING COMPOUNDS COMING UNDER THE GENERAL FORMULA $A^{I}B^{V}B_2^{VI}$. L. D. Dudkin and A. P. Ostranitsa. Doklady Akad. Nauk S.S.S.R. 124, 94-7(1959) Jan. 1.

The existence and physico-chemical properties of eight hypothetical compounds with general compositions $A^{I}B^{V}B_2^{VI}$ (Cu, Ag, Sb, Bi, Se, and Te) were investigated. The experiments uncovered only four possible compounds: $CuSbSe_2$, $AgSbSe_2$, $AgSbTe_2$, and $AgBiSe_2$. The temperature of ternary compound crystallization, the chemical bonding scheme, and electroconductivity dependence on temperature are presented graphically. (R.V.J.)

7799

ON THE EFFECT OF SILICON ON THE FORM OF GRAPHITE IN MAGNESIUM CAST IRON. A. V. Chernovol (Inst. of Machine Building, Academy of Sciences, Ukrainian SSR). Dopovidi Akad. Nauk Ukr. R.S.R. No. 5, 537-9(1958). (In Ukrainian)

The effect of silicon content on the form of graphite inclusions in magnesium cast iron was determined by means of microscopic analysis. It is shown that an increase of the silicon content to 6.8 to 6.85% (irrespective of the way it was introduced into the cast iron) does not alter the form of the graphite inclusions but only increases their number. (tr-auth)

7800

SOFTENING OF COLD-STRAINED LOW-CARBON STEEL AT HIGH SPEED ELECTRICAL HEATING. V. T. Cherepin. Dopovidi Akad. Nauk Ukr. R.S.R. No. 5, 540-3(1958). (In Ukrainian)

The processes of softening cold-strained low-carbon steel heated at 1700° and 4500° per sec were investigated. The samples were heated to different temperatures and immediately cooled by water. It was found that if steel is heated to 800°C, recrystallization occurs, leading to changes in the mechanical properties, microstructure, and fine crystalline structure. No more than 0.18 sec is required to complete the process of recrystallization at 4500° per sec. (tr-auth)

7801

SIMULTANEOUS DISCHARGE OF CADMIUM AND NICKEL IONS. D. P. Zosimovich and N. E. Nechayeva. Dopovidi Akad. Nauk Ukr. R.S.R. No. 10, 1075-8(1958). (In Ukrainian)

The equality of the deposition potentials of metals and the concentration of ions in the electrolyte does not in all cases result in the simultaneous discharge of ions. Investigations of the simultaneous discharge of nickel and cadmium ions have shown that only cadmium is deposited on the cathode in spite of the potentials of the two metals being close to each other and becoming still closer with a rise in temperature, and in spite of the concentration of both metals being equal in the electrolyte. The concentration of Ni in Cd varies from 0.0001 to 0.01% in the presence of 1N $NiSO_4$ in the electrolyte. (tr-auth)

7802

KINETICS AND MECHANISM OF HIGH TEMPERATURE OXIDATION OF TANTALUM IN THE RECRYSTALLIZED AND COLD-WORKED STATES. V. A. Lavrenko. Dopovidi Akad. Nauk Ukr. R.S.R. No. 10, 1079-82(1958). (In Ukrainian)

The temperature dependence equation of the product of the Ta $|Ta_2O_5|O_2$ galvanic cell electromotive force on oxide electroconductivity is found for the recrystallized and cold-worked states (t = 600 to 1000°C). The general equation of the electrochemical interaction of tantalum with oxygen is $2Ta + 5O_{(ads)} \rightarrow 2Ta^{5+} + 2xO_{(in\ Ta)} + 2x\square + (5-2x)O'' + 4xe^-$. (tr-auth)

7803

EFFECTS OF PHOSPHORUS AND ARSENIC ON THE α IRON CRYSTALLINE LATTICE PARAMETER AND HARDNESS. V. N. Svechnikov, V. M. Pan, and A. K. Shurin (Inst. of Metal Physics, Academy of Sciences, USSR). Fiz. Metal. i Metalloved. 6, 662-4(1958). (In Russian)

The crystalline lattice parameter and macro- and

microhardness dependence of α iron on phosphorus and arsenic content were investigated. The diagram of phosphorus solubility in α iron was plotted on the basis of x-ray-diffraction analysis. The tests were carried out with homogeneous alloys of high purity, melted in vacuum or argon media. It was found that phosphorus reduced and arsenic increased the α iron lattice parameter, and both arsenic and phosphorus considerably increased hardness. (tr-auth)

7804

METALLOGRAPHIC STUDY OF Al–Sn LIQUID ALLOY STRUCTURE. A. I. Bublik and A. G. Buntar (Gor'kii Kharkov State Univ.). Fiz. Metal. i Metalloved. 6, 692-9(1958). (In Russian)

Data are presented on the Al–Sn liquid alloy structure at various temperatures and concentrations. (R.V.J.)

7805

THE TEMPERATURE DEPENDENCE OF THE ELECTRICAL RESISTANCE OF NICKEL–COPPER AND NICKEL–CHROMIUM ALLOYS AND VAPOR DEPOSITED NICKEL AND PALLADIUM LAYERS, AND THE FERROMAGNETIC RESISTANCE ANOMALY AND THE CURIE TEMPERATURE. Hermann Joh. Bauer (Univ. of Munich). Z. Physik 153, 484-507(1959). (In German)

The temperature dependence of the electrical resistivity of nickel–copper and nickel–chromium alloys and of vapor deposited layers of nickel and palladium was measured. It was investigated by a quantitative relation between the ferromagnetic resistance anomaly and spontaneous magnetization. (tr-auth)

7806

MECHANICAL PROPERTIES OF NICKEL–COPPER ALLOYS. V. A. Pavlov and I. A. Pereturina (Inst. of Metal Physics, Urals Branch, Academy of Sciences, USSR). Fiz. Metal. i Metalloved. 6, 717-24(1958). (In Russian)

The temperature dependence of pure nickel and nickel alloy (with 10, 20, 40, and 60% Cu) yielding points was investigated. It was observed that the yielding point increases with the increase of copper content to 40% and drops beyond that point. It is shown that the nonuniform distribution of admixtures in the volume of solid solutions and diffusion processes are greatly responsible for the strengthening of the alloys. (R.V.J.)

7807

STRUCTURAL CHANGES IN SOLID SOLUTIONS OF TITANIUM AND NICKEL AT HIGH TEMPERATURES. V. M. Rosenberg and L. V. Gradova (Central Scientific Research Inst. of Ferrous Metals). Fiz. Metal. i Metalloved. 6, 765-7(1958). (In Russian)

The effects of slow plastic deformation on the microstructure and recrystallization of solid solutions of nickel with 3.6% Ti (annealed for 2 to 3 hours at 1200°C) were investigated in vacuum at 700 to 900°C. (R.V.J.)

7808

PLATING PROCESS CO-DEPOSITS OXIDES OR CARBIDES. A. E. Grazen (Platecraft of America, Inc., Buffalo). Iron Age 183, No. 5, 94-6(1959) Jan. 29.

A process is described that produces composite structures which may be used either as adherent coatings or electroforms. Coatings applied by this process greatly improve the life of gages, cutting tools, and other wear surfaces. The coatings are being tested on a number of production parts in the automotive, aircraft, and electrical fields, as well as household items. Results from some wear-resistance tests are reported. (J.H.M.)

7809

SEIGNETTOCERAMICS WITH HIGH CURIE TEMPERATURE. A. M. Cherepanov, S. V. Bogdanov, and R. Ya. Razbash (Lebedev Inst. of Physics, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R. Ser. Fiz. 22, 1497-9(1958) Dec. (In Russian)

A method of roasting lead-containing compounds, forming solid solutions of $BaTiO_3$–$PbTiO_3$ with 50 mole % $PbTiO_3$, is described. The properties of the resulting ceramics are given. (R.V.J.)

7810

INVESTIGATION OF AN ALLOY SURFACE WITH THE FIELD EMISSION MICROSCOPE. R. C. Bradley and L. A. D'Asaro (Cornell Univ., Ithaca, N. Y.). J. Appl. Phys. 30, 226-33(1959) Feb.

The field emission microscope was used to investigate the surface of an alloy of a few percent zirconium in molybdenum. The field emission patterns indicate that a high-temperature flash (2000°K) reduces the surface concentration of zirconium to zero. Subsequent heat treatment at 1000°K brings Zr to the emitting surface where it adsorbs preferentially in small clusters on the lattice steps of the {100} planes. These clusters are easily observed because of their high electron emission. Their emission characteristics reveal them to be smooth layers of low work function (2.94 ± 0.01 ev) rather than protruding crystallites. When the bulk concentration of zirconium in the alloy is increased from 1 to 5% the emission patterns change markedly but there is little effect on the adsorption characteristics of the surface. Surface migration, desorption, and bulk diffusion of zirconium were found to proceed rapidly at temperatures above 1200°K 1500°K, and 2000°K, respectively. Measurements of activation energies for surface migration and desorption gave 2.7 ± 0.3 ev and 4.15 ± 0.15 ev, respectively. (auth)

7811

ZIRCONIUM COATING OF URANIUM BY THE IODIDE PROCESS. W. L. Robb (Knolls Atomic Power Lab., Schenectady, N. Y.). J. Electrochem. Soc. 106, 126-9 (1959) Feb.

A method for coating uranium metal with a bonded layer of crystalline zirconium metal has been developed. It consists of thermally decomposing zirconium iodide vapors on the surface of uranium metal heated to about 1100°C in vacuum. Prior to coating, the uranium metal surface is cleaned by iodizing it and then vaporizing the uranium iodide. Greatly increased diffusion between the uranium and deposited zirconium can be obtained if the uranium is alloyed previously with as little as 0.5% zirconium. This increased diffusion improves the corrosion resistance of the coatings. (auth)

7812

ANOMALOUS CHANGES IN THE PROPERTIES OF ALLOYS DURING PHASE TRANSITIONS. M. E. Blanter and A. K. Mashkov (All Union Inst. of Machine Building). Metalloved. i Termich. Obrabotka Metal. No. 1, 6-10(1959) Feb. (In Russian)

Alterations in electric and plastic resistance during the phase transitions of alloys were investigated. Electric conductivity is shown on the kinetic diagram of carbon-free iron alloyed with 9.18% Cr at 815 to 850°. Plastic deformations were studied using austenite alloyed with 22.15% Ni and 2.52% Mn. (R.V.J.)

7813

HIGH YIELD STRENGTH AUSTENITE STEELS. A. P. Gulyaev and S. V. Lepnev. Metalloved. i Termich. Obrabotka Metal. No. 1, 10-15(1959) Feb. (In Russian)

The effects of alloying materials on the mechanical properties of austenite and martensite steels are shown graphically. The experiments used two sets of steels with various contents of Ni (20.9, 23, 24.3, and 28% Ni with 0.26% Cr, and 16.8, 18.4, 20.9, 21, 22.8, and 23.6% Ni with 0.41% C) annealed at 1100°C. The increased content of Ni reduces the strength and increases the plasticity. (R.V.J.)

7814

STAINLESS STEEL INTERCRYSTALLINE CORROSION FOLLOWING THERMAL TREATMENT. A. P. Akshentseva (Inst. of Scientific Research in Chemical Machine Building). Metalloved. i Termich. Obrabotka Metal. No. 1, 47-52(1959) Feb. (In Russian)

The effects of various thermal treatments on the microstructure and intercrystalline corrosion of stainless steel containing Cr, Cu, Mo, Ni, and Ti were studied at 500 to 1100°C. (R.V.J.)

7815

PRESSURE TUBE FUEL ELEMENTS, MANUFACTURING METHODS AND PROBLEMS. E. Bodmer, P. de Haller, and P. Sulzer. Nuclear Eng. 4, 5-8 (1959) Jan.

Pressurized tube fuel elements can offer technical and economic advantages over a pressure vessel in reactor design. A number of problems investigated are discussed, with particular reference to the manufacture of the internally cooled pressurized-tube elements proposed by a zone melting process. (W.L.H.)

7816

BORON AND BORON-CONTAINING MATERIALS. H. C. Cowen (United Kingdom Atomic Energy Authority). Nuclear Eng. 4, 11-17(1959) Jan.

The concentrations of B in the earth's crust along with the most important workable deposits are discussed. Methods of separating B isotopes are presented. The properties of B and B-containing materials are reported. The fabrication of B by powder metallurgy techniques is described. (W.L.H.)

7817

LIQUID METALS. J. W. Evans (United Kingdom Atomic Energy Authority, Culcheth, Lancs, Eng.). Nuclear Eng. 4, 59-63(1959) Feb.

The properties and individual characteristics of the liquid metals (Hg, Bi, Na, and Na–K) suitable for reactor coolants are presented. (W.L.H.)

7818

THE FUEL AND THE MODERATOR. Nuclear Power 4, 92-3(1959) Feb.

A complete mounting, polishing, and demounting setup which will be used at the Dounreay irradiated fuel element laboratory to aid the metallographic examination of hot specimens is presented. (W.L.H.)

7819

THE PRODUCTION OF URANIUM FUEL ELEMENTS. Research (London) 12, 76-8(1959) Feb.

A detailed description is given of the Springfield Uranium Processing Plant from the separation of the U from concentrates to the fabrication of fuel elements. (W.L.H.)

7820

PREPARATION OF THORIUM METAL IN A COMPACT STATE BY THE ELECTROLYSIS OF MELTED SALTS. Mints, Rafal'sky, and Bzhesky. Roczniki Chem. 31, No. 2, 741-2(1957). (Translated from Referat. Zhur. Khim. No. 16, 1958, Abstract No. 54598.)

Thorium metal was prepared in a compact state by the electrolysis of a melted mixture of Th, Zn, and Ca salts. The electrolysis was conducted in argon atmosphere at 1000 to 1200°C with a Mo cathode. The metal obtained contains 94.4% thorium, traces of zinc, and other impurities.

7821

X-RAY INTERFERENCE PATTERNS OF VAPOR DEPOSITED ALUMINUM LAYERS. Wolfgang Hink and Wolfgang Petzold (Univ. of Berlin). Z. angew. Phys. 10, 553-62(1958) Dec. (In German)

The reflecting power of aluminum layers of various thicknesses (250, 418.9, and 1045 A) on a glass support was numerically calculated with consideration of the absorption in the film and support for glancing incidence of x radiation (λ = 1.54 A). The Fresnel coefficient was indicated. The evaluation of the angularity of the calculated extreme of the reflecting power by the Kiessig layer thickness formula gave results which, within the error range of the differential method, agreed with that of the calculation based on the layer data. This proves the applicability of this approximation formula for the layer investigated. The accuracy with which layer thickness and refractive index determinations could be made by x-radiation interference was discussed. Thickness and refractive index of vapor-deposited aluminum films were measured in a range from 400 to 3000 A. The refractive index was found to be independent of the film thickness and is 1.3% over the value calculated for compact aluminum by the Lorentz formula. The error limit is 0.5%. The comparison of the thickness measured with x radiation with the value calculated from the vaporized mass shows that the cylindrical spiral used as the evaporating material behaves as a linear source. The measurement of the layer thickness by the Tolansky method gave in the same range a statistical deviation of 50 A in comparison with the x-ray thickness. (tr-auth)

7822

TEMPERATURE DEPENDENCE OF SHIFT MODULUS IN SOME PURE METALS, SOLID SOLUTIONS, AND ALLOYS. V. S. Postnikov (Kemerov State Pedagogical Inst.). Fiz. Metal. i Metalloved. 6, 706-16(1958). (In Russian)

The temperature dependence of the shift moduli of Co, Fe, Ni, Mo, and Ti and solid solutions of B, Be, C, Cr, Fe, Mn, Mo, Nb, Ti, W, and Zr in nickel alloys and alloys with nickel base were studied by low-frequency and ar pitude twisting vibration methods. Tabulated results are presented for pure metals tested at 800 to 900°C, the nickel-base alloys at 1100°C, and the solid solutions at 900 to 1030°C. Diagrams of the modulus shift and internal frictions at various temperatures are included. The obtained data show that the mean temperature coefficient for the β modulus shift is smaller for the solid solutions and nickel base alloys than for pure nickel. (R.V.J.)

7823

CALCIUM ZIRCONATE REACTIONS WITH B_2O_3 MINERALIZER. A. K. Kuznetsov (Inst. of Chemical Sili-

cates, Academy of Sciences, USSR). Zhur. Priklad. Khim. 31, 1799-1805(1958) Dec. (In Russian)

Phase studies were made of calcium zirconate reaction with mineralizer B_2O_3, and of the effects of admixtures on calcium zirconate sintering. Data on the thermal resistance properties of calcium zirconate were evaluated. The results show that admixtures of 2 $CaO \cdot B_2O_3$ to $CaZrO_3$ improve the characteristics of the refractory material. Due to the high coefficient of linear expansion and poor heat conductivity, the specimens with or without mineralizer have poor thermal resistance and can be used only in manufacturing refractory products for use in uniform (not fluctuating) temperatures. (R.V.J.)

7824

EFFECTS OF NITROGEN DILUTION OF CHLORINE ON METAL CORROSION AT ELEVATED TEMPERATURES. Kh. L. Tseitlin and V. A. Strunkin (Voroshilov Inst. of Organic Materials and Dyes). Zhur. Priklad. Khim. 31, 1843-9(1958) Dec. (In Russian)

The dilution of chlorine concentration with nitrogen retarded the corrosion rates of aluminum, iron and its alloys, tantalum, and to a lesser degree copper (above 230°), nickel (above 600°), and lead (above 250°). With the exception of aluminum, it did not effect the maximum temperature resistance of the metals. (R.V.J.)

7825

STRUCTURE AND PROPERTIES OF COBALT CONTAINING COPPER–ZINC, COPPER–TITANIUM, AND COPPER–ALUMINUM ALLOYS. Karlernst Müller. Thesis, University of Berlin, 1956. (In German)

The structural composition and age hardening of copper-rich copper–zinc–cobalt and copper–titanium–cobalt alloys and the age hardening of copper–aluminum–cobalt alloys were investigated. The solubility of cobalt, zinc, and titanium in copper mixed crystals was determined. The possible reasons for the behavior of the alloys during age hardening are discussed on the basis of the alloy structures. (J.S.R.)

7826

INVESTIGATION OF THE PROPERTIES OF HEAT RESISTANT IRON–ALUMINUM ALLOYS. Jaroslav Pluhař. pp. 97-115 in "Materiálový Sbornik, 1956." Prague, Matice Hornicko-Hutnicka, 1956. 191p.

The mechanical, physical, and chemical properties of the carbidic aluminum–iron alloy, Pyroferal, are reported. The bearing strength at high temperatures, weldability, and heat resistance of the welds are considered in detail. The conditions to prevent the decomposition tendency of this alloy are indicated. The properties of Pyroferal are compared with the heat resistance of chromium and chromium–nickel alloys. (auth)

7827

POWDER METALLURGY IN NUCLEAR ENGINEERING. Proceedings of the Conference on Powder Metallurgy in Atomic Energy, held October 20, 1955 in Philadelphia. Cleveland, American Society for Metals, 1958. 282p.

The general metallurgical problems in the design of nuclear reactors are described. The factors affecting sintering and the preparation of metal powders for reactors are presented. The powder metallurgy of Zr, Be, U, Th, and U alloys is described. The factors to be considered in alloying by powder metallurgical methods are described. The Be–Zr phase diagram is presented. Methods of rolling metal powders are described. The development of ceramic fuel materials for reactors is presented. Safe handling of pyrophoric and radioactive metal powders is described. (W.L.H.)

7828

INDUSTRIAL CARBON AND GRAPHITE. Papers read at the Conference held in London, 24th–26th September, 1957 with the discussions that followed. London, Society of Chemical Industry, 1958. 634p.

Sixty-eight papers were presented at the conference and they include the physical properties, manufacture, crystal structure, surface chemical properties and reactivity, electrical behavior and applications, and mechanical, chemical, and metallurgical applications of carbon and graphite. (W.L.H.)

PARTICLE ACCELERATORS AND HIGH-VOLTAGE MACHINES

7829 AERE-T/M-173

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

HIGH ENERGY IRRADIATION OF THE VACUUM ENVELOPE OF THE 7 GEV HARWELL SYNCHROTRON. J. W. Burren and D. Morgan. Nov. 1958. 39p.

Orbit calculations are made to estimate the probable distribution of high-energy irradiation of the upper and lower walls of the vacuum vessel of the Harwell Synchrotron. The irradiation consists of 7 Bev protons scattered out of the beam after passage through various targets. It is shown that on the average it will take several years to accumulate a damaging dose. However, more rapid damage could result over a small region from the prolonged use of small targets of low atomic number placed on the inside of the machine. (auth)

7830 ANL-5907

Argonne National Lab., Lemont, Ill.

THE ARGONNE 60-INCH CYCLOTRON. W. J. Ramler and G. W. Parker. Feb. 1959. 38p. Contract W-31-109-eng-38. $1.00(OTS).

A description of the Argonne 60-in. cyclotron along with its performance, operational characteristics, and housing with its associated facilities is presented. (J.E.D.)

7831 ANL-5956

Argonne National Lab., Lemont, Ill.

PARTICLE ACCELERATOR DIVISION SUMMARY REPORT [FOR] APRIL 15, 1958 THROUGH OCTOBER 1958. Feb. 1959. 55p. Contract W-31-109-eng-38. $1.50 (OTS).

Progress on various theoretical studies are reported. DC model magnet studies to determine the optimum size and position of correcting holes drilled in the magnet yoke are described. The major design criteria for the ring magnet are given. The current in the magnet of the 12.5 Bev proton synchrotron was calculated. The power supply characteristics and operating conditions are described. The side coil assembly phase of the ring magnet coil program is described. The radiofrequency system consisting of accelerating cavity, radiofrequency program, noise-measuring system, power amplifier, and beam induction electrodes is discussed. Detailed studies were made of the BNL Linac design and such

modifications were made as are required to meet the specific needs of the ANL injector system. Two methods of fabrication of the ring magnet vacuum chamber are discussed. A preliminary study and design was made of several vacuum pumping systems for the ZGS accelerator. Investigations on the vacuum properties of epoxy plastics, evapor-ion pumps, water flow control, and foundations are reported. (For preceding period see ANL-5864.) (W.D.M.)

7832 NP-7230
Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.
A DRIFT TUBE CALCULATION METHOD FOR LINEAR ACCELERATORS. Report No. 42/A-I. B. Kuchowicz. Nov. 1958. 11p.

A straightforward computation method is developed, which makes it possible to calculate the drift tube radii in linear accelerators when the other parameters are fixed. The method is applied to check some values obtained by a full-scale-model test. (auth)

7833 SCTM-443-58(51)
Sandia Corp., Albuquerque, N. Mex.
SANDIA VAN DE GRAAFF ACCELERATOR. A. D. Kantz. Dec. 1, 1958. 52p. Contract AT(29-1)-789. $9.30(ph), $3.60(mf) OTS.

An increasing interest in the effects of high-energy radiations on materials pointed out the necessity for increased research activity at Sandia Corporation in this field. A facility to control the mass, charge, energy, flux rate, and total dose of incident radiation to simulate radiations found in nuclear detonations is desirable. A survey of characteristics and the utilization of particle accelerators was made to determine the contribution of such facilities to the Sandia research programs. The operating principles of various accelerator types are enumerated. The large Bev machines are included to complete the summary of the present state of accelerator art, although these are not directly related to Sandia programs. The accelerator found most versatile for research use was a Van de Graaff generator. The facility established at Sandia is described in some detail. The general areas of radiation effects studies are briefly discussed to present a general background of the research program in radiation effects. (auth)

7834 UCRL-8345(Rev.)
California. Univ., Berkeley. Lawrence Radiation Lab.
THE PRESENT STATUS OF THE BEVATRON POWER SUPPLY. J. Gordon Harding, Harold W. Vogel, and Thomas W. Sibary. Nov. 1, 1958. 58p. Contract W-7405-eng-48. $1.75(OTS).

The description of the Bevatron power supply is brought up to date. Changes made since the original installation are described, and problems still encountered are treated. (auth)

7835
TWO PROCESSES FAVORING THE CAPTURE OF ELECTRONS UNDER BETATRON ACCELERATION CONDITIONS. A. P. Komar and Yu. S. Korobochko (Zhdanov Leningrad State Univ.). Doklady Akad. Nauk S.S.S.R. 123, 643-4(1958) Dec. 1. (In Russian)

Investigations were made of two effects in betatron acceleration capable of altering electron radial oscillation amplitudes by capturing some of the electrons. It was found that the first effect leads to a monotonous radial oscillation amplitude changes, in electrons injected in the direction of the external chamber wall, at the expense of the interactions taking place within the beam. The second effect leads to electron scattering by the inhomogeneity in the volume charge distributions appearing as the result of beam retention in a ribbon-like structure. (R.V.J.)

7836
16" VARIABLE ENERGY CYCLOTRON. Hiroo Kumagai, Kazuo Ŏno, Hisao Shōno, Izuo Hayashi, Keiichi Kuroda, and Minoru Imaizumi (Univ. of Tokyo). J. Phys. Soc. Japan 14, 1-9(1959) Jan.

A variable-energy 16 in. cyclotron was constructed to produce 1 to 2 Mev deuterons and 2 to 4 Mev α particles by new designs in its magnet and oscillator system. So far, deuterons in the energy range from 1.3 to 2 Mev and α particles in the range from 3 to 4 Mev are used for (d,p) and (α,p) reactions, Coulomb excitations, etc. Although the variation of accelerating energy for a cyclotron is a difficult problem, it has been found that it is possible, by some adjustments of the acceleration parameters of the cyclotron, to produce deuterons and α particles over a sufficiently wide range of energies within a minute. The cyclotron will be used for producing 2 to 4 Mev protons by changing a part of the resonator. (auth)

7837
THE VICKERS LINEAR ACCELERATOR. Nuclear Eng. 4, 9-10(1959) Jan.

Design of the 5 to 30 Bev Vickers linear accelerator is given. The 20 Bev unit would be some 3,700 meters long. (W.L.H.)

7838
THE MULTIPACTOR EFFECT IN A LINEAR ELECTRON ACCELERATOR. V. J. Vanhuyse, J. L. Verhaeghe, and J. Turf (Rijksuniversiteit, Ghent). Nuovo cimento (10) 10, 721-7(1958) Nov. 16.

Phenomena due to the multipactor effect and observed in the linear electron accelerator of the Ghent University are reported. An explanation is proposed for the variation of the anomalous attenuation due to the multipactor effect as a function of the R.F. power fed in the accelerator. (auth)

PHYSICS AND MATHEMATICS

General

Refer also to abstracts 8370 and 8401.

7839 AD-157158
Denmark. Tekniske Hojskole, Copenhagen.
ABSORPTION SPECTRA OF COMPLEXES OF HEAVY METALS. Final Technical Report for the period October 1, 1957 to September 30, 1958. Oct. 25, 1958. 99p. Contract DA-91-508-EUC-247.

The absorption spectra of a large number of complexes of 25 different elements were measured. A survey of the complex chemistry of several of the rarer elements, such as ruthenium, rhodium, palladium, rhenium, osmium, iridium, and platinum was made. The complexes with chloride, bromide, iodide, and thiocyanate were studied, and it was shown that the complexity constants of the chloro complexes are much smaller than usually indicated in literature (thus,

$[PdCl_4^{2-}]/[PdCl_3^-][Cl^-]$ is only 6). The immediate influence of NaOH and other bases on these halide complexes is often only to shift the oxidation state equilibria as Ir (III): Ir (IV) and Pt (II): Pt (IV), while the hydrolysis is much slower. The theoretical results of this investigation were more important than was realized at the beginning. The ligand field bands (caused by internal transitions in the partly filled shell) were observed of most complexes of the three transition groups. The very narrow, spin-forbidden bands, where the excited state has the same sub-shell configuration as the ground state, were observed in MnF_6^{2-}, $OsCl_6^{2-}$, and $OsBr_6^{2-}$. A comparative study is now possible of the tetragonal complexes of Pd(II) and Pt(II). The effects of intermediate coupling were studied in Re(IV) and Os(IV), and the old observations on Ni(II) further explained. The decrease of the interelectronic repulsion parameters in complexes, compared to the gaseous ions, was found to be smaller in the $4d^n$ (especially Mo(III)) and $5d^n$-complexes than previously expected from the large ligand field parameters of sub-shell energy differences in the latter groups. The electron transfer spectra of a large number of chloride, bromide, and iodide complexes, were studied and the formation of the highest complex (6 or 4 ligands) by excess of the ligand was established. It was concluded that isoelectronic central ions with the same set of ligands have the same number and over-all distribution of electron transfer bands, regularly shifted on the wavenumber scale as function of oxidation state and $4d^n$ versus $5d^n$. The systems d^5, where the excited state of the central ion is singly degenerate, make it possible to estimate the energy differences between the four different sets of molecular orbitals, formed by linear combination of the π-electrons from the six ligands. The differences evolving in the series d^3, d^4, d^5, and d^6 agree with the proposed model. The oxidation state Os(III) was identified from the electron transfer spectra of solutions of Os(IV) halides, reduced with Ag. The transitions which to some approximation are $S^2 \rightarrow sp$, were studied in complexes of tin(II), antimony(III), thallium(I), lead(II), bismuth(III) and compared with much information available in literature on similar ions in solids. Internal transitions in the ligands were studied in thiocyanate and cyanide complexes. (auth)

7840 AD-157592

Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

A MONTE CARLO METHOD FOR COMPUTING THE TRANSMISSION OF FAST NEUTRONS THROUGH A LEAD SHIELD (thesis). Jack Thomas Humphries. Mar. 1958. 64p.

A digital computer program, employing Monte Carlo techniques, was designed to compute the transmission of fast neutrons through a spherical lead shield. The source is contained in a void at the center of the shield, and surface fluxes are computed. Both elastic and inelastic scattering of the neutrons are considered by the program. Flow charts were constructed to facilitate coding. (auth)

7841 AECU-3938

General Electric Co. General Engineering Lab., Schenectady, N. Y.

TEMPERATURE DISTRIBUTION FOR TURBULENT FLOW THROUGH ANNULI FOR ANY CHOSEN AXIAL VARIATION OF HEAT FLUX OVER EACH OF THE TWO WALLS. M. Tribus, R. N. Noyes, and R. H. Norris. Nov. 1955. 17p. (R55GL368). $4.80(ph OTS); $2.70(mf OTS).

An analytical procedure is presented for calculating, for a long annular duct with concentric walls, the temperature rises of the inner wall, and of the outer wall, as a function of axial location. This procedure applies to a more general case than has heretofore been solved. The heat flux at the inner wall may now be different from that at the outer wall; each of these heat inputs may vary axially in any given manner. (auth)

7842 AECU-3990

Michigan Univ., Ann Arbor. Harrison M. Randall Lab. of Physics.

NUMERICAL TABLE OF BUTLER-BORN APPROXIMATION STRIPPING CROSS SECTIONS. C. R. Lubitz. 1957. 130p. $19.80(ph), $6.30(mf) OTS.

7843 AECU-3992

Case Inst. of Tech., Cleveland.

TETRAGONAL STRUCTURE OF INDIUM (thesis). Technical Report No. 4. Van E. Wood. Dec. 1958. 14p. Contract AT(11-1)-623. $3.30(ph), $2.40(mf) OTS.

It is shown that the tetragonal structure of indium may be accounted for on the basis of the electron theory of metals by demonstrating that, with suitable assumptions concerning effective masses of overlap electrons and other parameters, the total energy of the metal crystal is less for the observed c/a ratio than for a c/a ratio of unity, volume being preserved in the change of c/a ratio. No increase in the energy is found with further increase in c/a ratio. The effect of holes in the first Brillouin zone is also discussed. (auth)

7844 AECU-3998

Los Alamos Scientific Lab., N. Mex.

THERMOELECTRIC PROPERTIES OF THE PLASMA DIODE. H. W. Lewis and J. R. Reitz. July 25, 1958. 24p. Contract [W-7405-eng-36]. $4.80(ph), $2.70(mf) OTS.

An analysis of the plasma-filled diode is presented in terms of the thermoelectric powers of the plasma and metal branches. The area of interest is temperatures of 1000 to several thousand degrees K and plasma densities of 10^{12} to 10^{16} ions/cm^3. (T.R.H.)

7845 AECU-4000

Wisconsin. Univ., Madison.

CALCULATION OF THE G FACTOR FOR GAS SCATTERING EXPERIMENTS. Edward A. Silverstein. [195?]. 37p. $6.30(ph), $3.00(mf) OTS.

The "G factor" relating the yield to the beam intensity, target density, and scattering cross section is calculated for several types of aperture boundaries. The case of a front aperture composed of two parallel edges of infinite height with a rear aperture of any shape is calculated up to terms in the fourth derivative of the cross section. (W.D.M.)

7846 AECU-4014

Illinois. Univ., Urbana. Digital Computer Lab.

TECHNICAL PROGRESS REPORT. PART I. HIGH-SPEED COMPUTER PROGRAM. PART II. MATHEMATICAL METHODS. PART III. ILLIAC USE AND OPERATION—GENERAL LABORATORY INFORMATION. Dec. 1958. 20p. Contracts AT(11-1)-415 and Nonr-1834(15). $3.30(ph), $2.40(mf) OTS.

Progress is reported on computer development, mathematical methods, and ILLIAC use and operation. (For preceding period see AECU-3975.) (T.R.H.)

7847 AERE-Inf/Bib-90(Suppl.2)

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

CHERENKOV RADIATION AND ITS PRACTICAL APPLICATIONS—A BIBLIOGRAPHY. B. J. Wilson. Dec. 1958. 13p. $0.35(BIS).

This bibliography consists mainly of references to articles and reports which have appeared since December 1956 and is intended to supplement AERE Inf/Bib 90 and Inf/Bib 90 Supplement 1. The bibliography includes major references to the literature on Cherenkov radiation, counters, and detectors. (J.E.D.)

7848 AERE-T/R-2789

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

A PROGRAM FOR SOLVING THE NEUTRON TRANSPORT EQUATION BY CARLSON'S S_N METHOD ON THE FERRANTI MERCURY COMPUTER. H. E. Wrigley. Dec. 1958. 18p.

A program was written for the Ferranti Mercury Computer which solves the neutron transport equation by Carlson's S_N method. An outline of the method is included. The program solves the time-independent transport equation in symmetric, spherical, and cylindrical geometries. It assumes discrete neutron energy groups and isotropic neutron scattering and emission. (A.C.)

7849 APAE-Memo-162

Alco Products, Inc., Schenectady, N. Y.

IBM 650 COMPUTER—PROGRAM NUMBER 655; COLLATION OF ROC CODE OUTPUT. C. J. Stueck. Dec. 19, 1958. 5p. Contract AT(30-3)-326. $1.80(ph), $1.80(mf) OTS.

Using the output of programs 653 and 654, each card of which contains the dose information for one dose point at one energy, program 655 produces the sum of the dose values of all energies for one dose point. Program details are given including 650 input and output formats, operating instructions, and guides. (auth)

7850 ASAE-S-12

American-Standard. Atomic Energy Div., Mountain View, Calif.

SOME MONTE CARLO CALCULATIONS FOR CYLINDRICAL AND CRUCIFORM CONTROL RODS. J. M. McCampbell and K. T. Chow. June 30, 1958. 18p. Contract AT(04-3)-231. $3.30(ph), $2.40(mf) OTS.

A limited investigation of neutron absorption was conducted to examine the relative effectiveness of cruciform and cylindrical control rods. If such data could be firmly established, reactors using cruciform rods could be readily analyzed by transforming the rods to their cylindrical equivalent then applying traditional theories. Conversely, the number of rods required in a reactor and their location could be determined for cylindrical rods then transformed to equivalent cruciform rods. In the present context, only the cruciform rods are of engineering interest; the cylindrical rods are merely an analytical device. The Monte Carlo method was selected for this study to minimize the number of approximations required. The ease with which it can handle complex geometries makes this method particularly attractive for the control rod problem, but it often becomes very expensive to follow a sufficient number of neutrons to achieve satisfactory statistics. The project was, in part, an experiment to determine if this type of problem could be solved with reasonable accuracy at a reasonable cost with Monte Carlo. (auth)

7851 KAPL-M-S3G-RES-61

[Knolls Atomic Power Lab.], Schenectady, N. Y.

AN ANALYSIS OF THE CONTROL ROD COOLING PROBLEM WITH APPLICATION TO SAR GEOMETRIES. J. W. Millard. Jan. 6, 1959. 46p. Contract W-31-109-Eng-52. $7.80(ph OTS); $3.30(mf OTS).

An analysis is presented which enables the design engineer to establish the proper amount of coolant flow to be bypassed into the control rod channel. Required inputs to the analysis are the heat generation, the total reactor flow, and the physical dimensions of the rod–channel combination. The analysis is extended to the specific case of the SAR configurations and the results presented in the form of curves which permit rapid evaluation of the thermal performance of the possible SAR rod–channel combinations. (auth)

7852 NAA-SR-3376

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

NEUTRON MODERATION BY CHEMICALLY BOUND HYDROGEN. E. U. Vaughan and E. R. Cohen. Jan. 15, 1959. 17p. Contract AT-11-1-GEN-8. $0.50(OTS).

The fact that level spacings of chemically bound protons are considerably larger than thermal energies at typical reactor temperatures necessitates including the effects of binding in treating neutron thermalization by hydrogenous moderators. Following Fermi, the effects of the binding have been studied by treating the proton states as those of an isotropic harmonic oscillator. This model is excellent for zirconium hydride and may give useful insight into other hydrogenous moderators. The neutron flux spectrum at absolute zero and the effects of temperature on reactivity are discussed. (A.C.)

7853 NEPA-1480

[National Bureau of Standards, Washington, D. C.]

CREEP TESTS ON GRAPHITE. M. D. Burdick and B. Zweig. June 23, 1950. 4p. For [Fairchild Engine And Airplane Corp. NEPA Div. Contract W-33-08-ac-14801(16250)].

Results are given from tests at 2000°F at stresses between 1000 and 2000 psi. (D.E.B.)

7854 NP-6969

Massachusetts Inst. of Tech., Cambridge, Naval Supersonic Lab.

ON SOME FUNDAMENTALS IN MAGNETO-FLUID-MECHANICS (thesis). Technical Report 247. Eugene E. Covert. Mar. 1958. 307p.

The basic equations of magneto-fluid-mechanics are derived from classical kinetic theory for a gas consisting of neutral particles, positive particles (ions), and electrons. Included are the equations of conservation of mass and momentum for each type of particle, an energy equation, the Maxwell equations of electrodynamics, and suitable state equations. The basic equations are normalized and the resulting dimensionless parameters are discussed. Formulas for the fluid properties are presented, and a summary of the values of these properties is given. Some elementary solutions are given to illustrate the nature of magneto-fluid interactions. The problem of adding energy to a gas by magneto-fluid mechanical means is discussed and it is concluded that these means are practical only at high power densities (i.e., 700 kw/ft^2 ~ 5 × 10^6 Btu/sec-ft^2). A device which absorbs such power densities and generates a plasma is discussed theoretically and some preliminary experimental results from this device are given. (auth)

7855 NP-7152

Brussels. Centre d'Étude de l'Énergie Nucléaire.

CHOIX D'UN CRISTAL MONOCHROMATEUR DE NEUTRONS. (Selection of a Crystal Monochromator of

Neutrons.) S. Hautecler and H. Pollak. Jan. 23, 1958. 60p.

A number of common crystals were studied under the same conditions to determine their performance as neutron monochromators in reflection and transmission. The results of the study show that the best reflector for slow neutrons is diamond and the best transmitter for fast neutrons is beryllium. (J.S.R.)

7856 NP-7200

Boston Coll., Chestnut Hill, Mass.

PROPULSION OF IONIZED GAS BY A HIGH MAGNETIC FIELD. Final Technical Report [for] June 1, 1958 to November 30, 1958. William G. Guindon and Joseph F. McNulty. 14p. DA Project No. 599-01-004. Contract DA-19-020-ORD-4644.

From observations of interactions between plasmoids and magnetic fields, it is thought that these plasmoids can be accelerated, thus increasing their energy, by properly injecting them into a field of this type. Procurement, design, and assembly of equipment are described for measurement of plasmoid motion in high magnetic fields. (J.R.D.)

7857 NP-7204

Massachusetts Inst. of Tech., Cambridge. Div. of Industrial Cooperation.

LIQUID AND GAS DISTRIBUTIONS IN A TWO-PHASE BOILING ANALOGY. Technical Report No. 13. Graham B. Wallis and Peter Griffith. Dec. 1, 1958. 74p. DSR Project No. 7-7673, Contract N5ori-07894.

A description of the design and operation of an experimental apparatus for the analysis of two-phase flows similar to those occurring in boiler tubes at low pressures is presented. Velocity and density profiles of air-water mixtures are determined across a passage in which boiling conditions are simulated by pumping air through porous walls into a water stream. Photographs of the flow patterns are also presented as a qualitative check on the quantitative data. The results obtained include: velocity and concentration profiles of the two phases for various values of the flow rates of each, and a classification of the flow into several patterns or regimes with quantitative data describing each regime. The data are suitable for use in comparing the physical phenomena with mathematical models and for developing a more accurate theoretical treatment of the flow of boiling fluids in heated channels. (auth)

7858 NP-7205

Massachusetts Inst. of Tech., Cambridge. Div. of Industrial Cooperation.

THE ROLE OF SURFACE CONDITIONS IN NUCLEATE BOILING. Technical Report No. 14. Peter Griffith and John D. Wallis. Dec. 1, 1958. 28p. DSR Project No. 7-7673. Contract N5-ori-07894.

Nucleation from a single cavity was studied indicating that cavity geometry is important in two ways. The mouth diameter determines the superheat needed to initiate boiling and its shape determines its stability once boiling has begun. Contact angle is shown to be important in bubble nucleation primarily through its effect on cavity stability. Contact angle measurements made on "clean" and paraffin coated stainless steel surfaces with water show that the contact angle varies between 20 and 110° for temperatures from 20 to 170°C. On the basis of single cavity nucleation theory, it is proposed to characterize the gross nucleation properties of a given surface for all fluids under all conditions with a single group having the dimensions of length. Finally, it is shown experimentally that this characterization is adequate by boiling water, methanol and ethanol different copper surfaces finished with 3/0 emery, and showing that the number of active centers per unit area is a function of this variable alone. (auth)

7859 NP-7234

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

THE INFLUENCE OF POLARIZATION OF LIQUID CRYSTAL MOLECULES ON THE SCATTERING OF SLOW NEUTRONS. Report No. 48/II; I-B. J. Janik, S. Krásnicki, and A. Murasik. Dec. 1958. 9p.

The transmission of monoenergetic neutrons passing through a layer of p-azoxyanisol was measured. Differences in counting rates between an unpolarized sample and a polarized in magnetic field one were obtained. The effect was interpreted in the light of Krieger and Nelkin's theory and of some assumptions of the molecular structure of the investigated substance. (auth)

7860 NP-7264

Massachusetts Inst. of Tech., Cambridge. Solid-State and Molecular Theory Group.

QUARTERLY PROGRESS REPORT NO. 31. Jan. 15, 1959. 56p. Contract Nonr-1841(34).

X-ray and neutron scattering from electrons in a crystalline field was investigated to determine the outer electron configurations in iron and nickel. The ordinary energy-band calculation for iron, using as close an approach to a self-consistent field as is feasible, indicates that most of the outer electrons should be of the 3d-type, with only about one electron per atom of the 4s-4p type. Progress on various types of crystalline problems are reported. The computer programming problems are briefly reviewed. (For preceding period see NP-7010.) (W.D.M.)

7861 NP-7286

Lehigh Univ., Bethlehem, Penna. Inst. of Research.

A STUDY OF THE PROCESSES INDUCED BY THE REFLECTION OF STRONG SHOCKS IN NITROGEN. Technical Report No. 13. Robert G. Jahn and Fred A. Grosse. Sept. 15, 1958. 42p. Project NR 061-063. Contract N7-onr-39302.

Electrical and optical effects accompanying the reflection of Mach 6 shock waves in nitrogen from the end wall of a shock tube are studied experimentally by a series of complementary techniques involving thin-film resistance thermometers, internal and external electrostatic probes, 3 cm microwave absorption probes, spectrograms, photocells, interferograms, and luminosity photographs. The reflected shock is found to be badly distorted by its interaction with the boundary layer on the tube wall, thereby leaving a nonuniform gas zone behind it. The brilliant luminosity of this hot gas, due primarily to a minute sodium impurity, is also nonuniform, both radially and longitudinally, but has a distinct leading edge. This same zone of gas displays an average free electron density $\sim 10^{13}/cm^3$, also attributable to easily ionized impurities, which renders it electrically conducting and establishes internal potentials detectable far from the zone itself. Within the 3 to 10% resolution of the experiments, the luminous front and the free charge front are coincident and travel at a uniform velocity of ~650 m/sec, about 10% higher than the theoretical value for a one-dimensional shock reflection process. (auth)

7862 NP-7289
Naval Research Lab., Washington, D. C.
NRL QUARTERLY ON NUCLEAR SCIENCE AND TECHNOLOGY. Progress Report for the Period October–December 1958. Jan. 1, 1959. 49p.

An alternative theory of the neutrino is offered. An apparatus using a variable speed motor drive is described for measuring particle track and gap lengths in nuclear emulsions. A semiautomatic device for measuring particle track profiles is also described. Experimental measurements of gamma scattering by the 4.46- and 5.03-Mev states of B^{11} are reported. The form of the scattering state vectors in fixed-source meson theory is considered, assuming knowledge of the ground state. An expansion for these scattering states is presented and related to the variational method and the Chew–Low method. Progress in the study of avalanche activity in self-quenching counter tubes is reported. Reports on dispersion relations for some simplified electron beams, and stability analysis of the electron beam in a Budker-type accelerator are given. Study of the effects of radiation on poly-α-methylstyrene continued. A table is presented which facilitates calculation of absorbed dose of electromagnetic radiation from exposure dose. The mechanism of stress-corrosion cracking in mild steel under steam power operation conditions was further investigated. (For preceding period see NP-7070.) (T.R.H.)

7863 NP-7290
Rice Inst., Houston, Tex.
ELECTRON EMISSION FROM PLASTICALLY STRAINED ALUMINUM. Technical Report No. 1. W. D. Von Voss and F. R. Brotzen. Dec. 31, 1958. 36p. ONR Contract 2116(02).

Aluminum was strained in tension under a Geiger-Mueller counter. Both the electron emission associated with plastic deformation and the subsequent delayed emission were observed. An attempt was made to correlate quantitatively the emission rates with the mechanical variables, i.e., strain and rate of deformation. The model used for this correlation links point imperfections formed during deformation with the emission from the oxide surface film. (auth)

7864 NP-7302
Illinois Inst. of Tech., Chicago.
A STUDY OF ORDER IN Au_3Cu. Technical Report No. 2. Francois d'Heurle and Paul Gordon. Oct. 1958. 102p. Contract Nonr-1406(03).

A battery of three isothermal jacket microcalorimeters is specially conceived to study the evolution of small quantities of heat occurring over long periods of time at low temperature. At 100°C these calorimeters are capable of a sensitivity of 0.002 calories per hour and about twice this amount at 200°C. The calorimeters have been used for the study of the poorly known yet important order-disorder transformation of Au_3Cu. With the help of x-ray diffraction it has been shown that ordering of a previously disordered sample proceeds in three stages. The first stage corresponds to the formation of short-range order, the second stage to the growth of long-range order domains simultaneously with an over-all increase of the degree of order, and the third stage to a further growth of the domains alone. The critical temperature has been determined as 209 to 212°C. It is believed that the reaction occurs in conditions such that equilibrium is not reached. As a result the usual classification of reaction into first, second, etc., order does not apply. Thus, while the transformation is not marked at the critical temperature by a latent heat which can be experimentally detected it would be meaningless to classify it as a higher order transformation. The total enthalpy change between a completely ordered and a completely disordered sample is estimated to be 375 calories per mole from a maximum observed value of 320 calories per mole. It has been found that quenched-in defects presumably vacancies can play a very important role in ordering transformations. At 100°C, in a quenched sample, the rates of ordering can be more than a thousand times greater than would be calculated on the basis of the rates observed at 190°C. The quenched-in vacancies do not only contribute to the speed of the transformation, they also help in bringing the alloy closer to true equilibrium conditions than would be otherwise possible. (auth)

7865 NYO-8796
Rochester, N. Y. Univ.
ANALYTIC PROPERTIES OF EXPECTATION VALUES OF PRODUCTS OF FIELD OPERATORS. Lectures given by Dr. Abdus Salam. Appendix by Dr. S. Okubo. Notes compiled by F. Troyon. Dec. 15, 1958. 70p. Contract AT(30-1)-875. $12.30(ph), $4.50(mf) OTS.

A review is presented of the latest work on the axiomatic approach of field theory. An account is given of recent work in dispersion theory. (A.C.)

7866 ORNL-2641
Oak Ridge National Lab., Tenn.
DETERMINATION OF THE NEUTRON DIFFUSION PARAMETERS IN ROOM-TEMPERATURE BERYLLIUM. G. deSaussure and E. G. Silver. Feb. 27, 1959. 35p. Contract W-7405-eng-26. $1.25(OTS).

The pulsed neutron method was used to determine the diffusion parameters of thermal neutrons in beryllium at room temperature. The following values were obtained: inverse lifetime $v\Sigma_a = 288 \pm 60$ sec^{-1}, diffusion constant $D = (1.25 \pm 0.06) \times 10^5$ cm^2/sec, diffusion cooling constant $C = 1.1 \pm 0.9$ cm^2. The experiment and the method of analyzing the data are described, and the results are compared with those obtained by other groups. (auth)

7867 SCDC-803
New Mexico Coll. of Agriculture and Mechanic Arts, State College. Physical Science Lab.
AER 20-B ON THE COVARIANCE SPECTRUM OF TWO POINTS ON A RADAR TERRAIN RETURN PULSE. July 19, 1956. Changed from OFFICIAL USE ONLY Feb. 6, 1959. 14p. For Sandia Corp. $3.30(ph), $2.40 (mf) OTS.

The first section discusses the covariance spectrum of the fluctuations in the return power at two different elapsed times for a radar terrain signal. Section two gives some experimental results and discusses their conformity with some simple theoretical predictions. Section three contains a brief discussion of the application behind the study and an outline of the direction of future work. (W.L.H.)

7868 SCDC-804
New Mexico Coll. of Agriculture and Mechanic Arts, State College. Physical Science Lab.
AER 21 A ON REFLECTION AND SCATTERING COEFFICIENTS FOR VARIOUS TARGET SITES. Nov. 19, 1956. Changed from OFFICIAL USE ONLY Feb. 6, 1959. 29p. For Sandia Corp. $4.80(ph), $2.70(mf) OTS.

Scattering coefficients were calculated from data from

the "high" units at various altitudes and for various target sites. The results of these calculations are given. (W.L.H.)

7869 SCTM-386-58(51)
Sandia Corp., Albuquerque, N. Mex.
ANALYSIS OF WIND-TUNNEL DYNAMIC STABILITY TESTING METHODS AND DATA REDUCTION. Rodman N. Leach. Oct. 24, 1958. 21p. Contract AT(29-1)-789. $3.30(ph), $2.40(mf) OTS.

The method of data reduction employed for dynamic stability wind-tunnel tests is discussed, and suggestions to improve the quality of the data are made. (auth)

7870 SCTM-413-58(12)
Sandia Corp., Albuquerque, N. Mex.
VOLUME, WEIGHT, CENTER OF GRAVITY, AND MOMENTS OF INERTIA OF RINGS WHOSE CROSS SECTIONS ARE RIGHT TRIANGLES. G. W. Hughes. Jan. 14, 1959. 13p. Contract AT(29-1)-789. $3.30(ph), $2.40(mf) OTS).

Equations and graphs are presented which may be used to facilitate the calculation of the volume, weight, center of gravity, and moments of inertia of a ring whose cross section is a right triangle. (auth)

7871 SCTM-442-58(51)
Sandia Corp., Albuquerque, N. Mex.
RESULTS OF A WIND-TUNNEL TEST OF EXTERNAL ANTENNAS. R. J. Loncharich. Sept. 1, 1958. 66p. Contract AT(29-1)-789. $10.80(ph), $3.90(mf) OTS.

Thirteen full-scale external antenna configurations were force-tested in a wind tunnel. The models were mounted on a splitter plate to simulate a thin boundary layer condition and on a side wall of the tunnel to simulate a thick boundary layer condition. Test data are presented graphically and discussed relative to the general problem of antenna design from an aerodynamic standpoint. The range of test Mach numbers was from 1.5 to 3.5. (auth)

7872 SCTM-453-58(51)
Sandia Corp., Albuquerque, N. Mex.
PRESSURE CALIBRATION OF A REFLECTION PLANE IN THE SANDIA 12-INCH TRANSONIC WIND TUNNEL. (PROGRAM III–40). Rodman N. Leach. [1958]. 15p. Contract AT(29-1)-789. $3.30(ph), $2.40(mf) OTS.

Results of pressure tests of a reflection plane in the Sandia 12-inch transonic wind tunnel to determine lateral and longitudinal Mach distribution over the plate at $0.5 \leq M \leq 1.30$ are presented. Comparisons are made with another Sandia reflection plane which was tested subsonically, and with the centerline calibration of the 12-inch tunnel at supersonic speeds without the plate. Calibration plots of the reflection plane are presented. (auth)

7873 TID-3526
Technical Information Service Extension, AEC.
SYMPOSIA IN FIELDS RELATED TO ATOMIC ENERGY. A Literature Search. Theodore F. Davis and Raymond L. Scott, comps. Feb. 1959. 20p. $0.50 (OTS).

References are given to 118 unclassified AEC reports and 42 unclassified non-AEC reports on symposia in the fields related to atomic energy. (J.E.D.)

7874 UCRL-5258
California. Univ., Livermore. Lawrence Radiation Lab.
GETTERING HYDROGEN AT ULTRA-LOW PRESSURES BY EVAPORATED METAL COATINGS. Norman Milleron and E. C. Popp. Nov. 1958. 16p. Contract W-7405-eng-48. $3.30(ph), $2.40(mf) OTS.

Results for pumping neutral hydrogen gas in 1-sec pulses by the gettering action of an evaporated coating of molybdenum are presented. One-sec gas in-puts are observed at equivalent pumping speeds $>10^4$ liters/sec at 1×10^{-8} mm Hg in a 70-liter volume system. Base pressures $< 1 \times 10^{-10}$ mm Hg are achieved by gettering with the static evaporated coating and pumping with a 4-in. oil diffusion pump simultaneously. Criteria for choice of gettering metal and a brief outline of pumping requirements for controlled fusion devices called pyrotrons are included. (auth)

7875 UCRL-8568
California. Univ., Berkeley. Lawrence Radiation Lab.
ENERGY SPECTRA AND ANGULAR DEPENDENCES OF NEUTRONS FROM THE 31.5-MEV PROTON BOMBARDMENT OF BERYLLIUM-9, NITROGEN-14, AND ALUMINUM-27 (thesis). Harold E. Adelson. Dec. 11, 1958. 117p. Contract W-7405-eng-48. $2.75(OTS).

The energy spectra and absolute differential cross sections of neutrons of energy greater than 5 Mev emitted from thin targets of beryllium, nitrogen (melamine), and aluminum bombarded by 31.5-Mev protons were measured at three angles (53, 90, and 127°). The 4-in. hydrogen bubble chamber was used as a neutron spectrometer. A fast data-reduction system for the analysis of the recoil-proton tracks was developed utilizing a commercial electronic coordinate-measuring device, the IBM punch-card system, and the IBM 650 digital computer. The resolution of the entire spectrometer system was determined by measuring the monoergic (14.1-Mev) neutron spectrum from the $T(d,n)He^4$ reaction. The full width at half maximum of the measured peak was 10% of the peak energy. The energy spectra from the beryllium and nitrogen bombardments contained structure that may correspond to levels in the residual nuclei of the $Be^9(p,n)B^9$ and $N^{14}(p,n)O^{14}$ reactions. Poor statistics did not permit definite level assignments, but several of the possible levels of B^9 correspond to known levels of its mirror nucleus, Be^9. The angular dependence of the neutron production above 5 Mev from all three targets shows a forward asymmetry. The production from aluminum, which was the heaviest target bombarded, and for which the neutron-production mechanism might be expected to be the compound model, was in a ratio of 5:3:2 for 53, 90, and 127° (lab), respectively. This forward asymmetry is not to be expected from the compound model, and appears to indicate a predominance of the direct-interaction mechanism for the higher-energy neutrons. (auth)

7876 WADC-TR-58-610
Aerojet-General Corp., Azusa, Calif.
EXPERIMENTAL STUDIES ON HEAT TRANSFER AND FLUID FLOW. Final Progress Report (Volume II) for January 1 through September 30, 1958. E. L. Geery, L. Green, Jr., and W. R. Thompson. Nov. 1958. 39p. Project No. 3151. Contract AF33(616)-5552. (AGC-1520(Vol. II)).

Initial tests of the equipment for the liquid nitrogen heat transfer experiment were conducted. The investigation of heat transfer to liquid hydrogen reached the design and procurement stage, and a high-pressure cryogenic tank was ordered fabricated. (auth)

7877 WAPD-TH-23
Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.

CYCLIC HEAT TRANSFER ANALYSIS FOR PLATES. B. W. Le Tourneau and R. E. Grimble. Feb. 15, 1955. 9p. $1.80(ph OTS); $1.80(mf OTS).

In order to determine the average heat transfer coefficient in a plate-type subassembly by the method of cyclic temperature variations, an analytical solution for the heat transfer between the plates and the fluid is required. In applying the method to plates of prototype thicknesses, composed of materials such as zirconium, a need arises for an analytical solution for the case of finite thermal conductivity in the plates normal to the flow. Such a solution has been worked out and is presented. (auth)

7878 WAPD-TM-46(Add.)

Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
A CODE TO INVERT THE FOURIER SINE OR COSINE TRANSFORM — FTI-2. W. H. Guilinger, H. G. Kuehn, and R. S. Varga. Oct. 1958. 11p. Contract AT-11-1-GEN-14. $0.50(OTS).

An IBM-704 code, FTI-2, which generalizes FTI-1 to include sine inversions and several other improvements is presented. Among the changes explained are alterations in spacing, interpolation, and strategy. Although FTI-2 is a big improvement over FTI-1 in terms of accuracy and speed, there are still problems of slow convergence with respect to the φ series. (auth)

7879 WIS-AEC-8

Wisconsin. Univ., Madison. Naval Research Lab.
THE ENERGY OF INTERACTION BETWEEN TWO EXCITED HYDROGEN ATOMS. Bruno Linder and Joseph O. Hirschfelder. Nov. 12, 1956. 92p. Contract AT(11-1)-298. $15.30(ph), $5.40(mf) OTS.

A complete set of potential energy curves arising from the interaction of two excited hydrogen atoms, with 2s and 2p electrons, is given for intermediate to large separations. Accurate results were obtained for the first-order perturbation energies by using exact integrals and properly symmetrized wave functions with an effective nuclear charge of one; ionic or polar terms were not included. Approximate values were obtained for the second-order perturbation energies by using nonsymmetrized wave functions and omitting all terms in the perturbation Hamiltonian beyond the leading one. For most states, the second-order perturbation energies were found to contribute little to the total interaction energy even at large distances, where, due to dipole-dipole, dipole-quadrupole and quadrupole-quadrupole couplings, the first order perturbation does not vanish. All triplet Σ and π states were found to lie lower than the corresponding singlet states, contrary to the generally accepted hypothesis that states with opposite spin are most stable. Tables of integrals involving 2p and hydrogenic 2s orbitals are given. (auth)

7880 Y-B4-59

Carbide and Carbon Chemicals Co. Y-12 Plant, Oak Ridge, Tenn.
SELECTED PHYSICAL PROPERTIES OF POTASSIUM AND POTASSIUM HYDROXIDE IN THE TEMPERATURE RANGE 100 TO 1000°C. Rosalie L. Curtis. Sept. 23, 1952. Decl. Dec. 22, 1958. 16p. Contract W-7405-eng-26. $3.30(ph), $2.40(mf) OTS.

A bibliography of the physical properties of K and KOH in the temperature range of 100 to 1000°C is presented. The physical properties include density, heat capacity, surface tension, thermal conductivity, vapor pressure, and viscosity. No information was found on the heat capacity and thermal conductivity of KOH. (J.E.D.)

7881 ZPH-020

Convair, San Diego, Calif.
SEMI-ANNUAL PROGRESS REPORT. Oct. 1, 1958. 335p.

Nuclear Physics. Measurement of the angular distribution of elastically scattered 5.6-Mev neutrons from carbon is reported. The experimental procedure to be used for measuring neutron capture cross sections for elements and separate isotopes bombarded by neutrons in the low kev-energy region is presented. Solid State Physics. The solid state group has placed in operation a Hitachi Hu-10 electron microscope. Replica techniques used in electron microscopy are discussed. The optical properties of solids in the vacuum ultraviolet are discussed. A general mathematical method is being developed by which optical constants (such as the real index of refraction and the absorption coefficient) as a function of frequency or photon energy can be derived from reflectivity measured as a function of frequency. Samples of ZnO are being prepared for photodesorption experiments. The sputtering from hypersonic vehicles in the free molecule flow region is discussed. An estimate of the threshold energy variation with incident angle is derived, based on a single collision model. Microwave propagation through a contaminated plasma is discussed. The solid state group has considered the possibility of using electric-dipole transitions in solids for maser applications in the millimeter and submillimeter range. Upper Atmosphere Physics. The principles of electrohydrodynamics which describe the motion of a charged body in a plasma are applied to typical satellite motions, and numerical estimates are obtained for various quantities of interest. Among these are the drag, the Mach cone angle, and the increase in ionization across the Mach cone. Plasma Physics. The electrostatic field about an ion moving slowly through a highly ionized gas is being investigated to determine how this field becomes distorted when the ion under consideration moves with velocities small compared to the mean thermal velocity of ions in the gas. The electron density in the wake of a slightly charged body moving through a highly ionized gas is being investigated. The charge accumulation on the surface of a sphere in the extreme upper atmosphere is being investigated. Molecular Physics. Phenomenological formalism is presented for chemical reactions, dissociations, excitations, and the reverse processes in gaseous mixtures. General thermodynamic expressions are derived for the equilibrium of a multicomponent mixture of reacting real gases with radiation, with special emphasis on adiabatic expansion. A graph giving electron concentration for argon-free air in equilibrium is given. A method of solution is presented for generalized isentropic flows and normal shock for high-temperature gases. The thermodynamics of the upper atmosphere and its influence on gas properties behind shocks is presented. A method is being developed for calculating the cross sections for scattering of very slow electrons by nitrogen and oxygen atoms. Molecular Beam Research. Measurements are in progress on the total cross sections for scattering of electrons by atmospheric species. These cross sections are needed for determining the microwave transmissivity, reflectivity and refractivity of the shocked air surrounding hypersonic vehicles that are in the continuum region of the earth's atmosphere. Applied Mathematics. Flow field calculation is presented with real gas effects. Development of numerical techniques is presented. Theoretical work now strongly indicates that a signifi-

cant reduction of heat transfer to a blunt body in a hypersonic stream can be effected by using a magnetic field built into the body. Physical Mechanics. A study of heat transfer in the free molecule flow region is presented. This study was undertaken for the purpose of examining the effect of the recombination of the monatomic oxygen which exists in the atmosphere upon the heat transfer to a body moving in the free molecule flow region. Progress made in shock tube research and methods of obtaining temperatures behind a shock front are reported. An outline is presented of the blast wave theory. An analytical heat transfer solution is derived and evaluated for the general case of a turbulently flowing liquid metal which suddenly encounters a step-function boundary temperature in a channel system. (W.L.H.)

7882 AEC-tr-3493

PROPAGATION OF ELECTROMAGNETIC WAVES IN A PLASMA (IONOSPHERE). (Rasprostranenie Elektromagnitnykh Voln v Plazme (Ionosfere).) B. N. Gershman, V. L. Ginzburg, and N. G. Denisov. Translated by David Franklin from Uspekhi Fiz. Nauk 61, 561-612 (1957). 83p. $1.00(OTS).

Some problems in the theory of propagation of electromagnetic waves in a plasma are considered. Topics discussed include wave propagation in a homogeneous magnetoactive plasma with the electron and ion motion taken into account, wave field in a nonhomogeneous isotropic plasma, behavior of the field, interaction of the ordinary and extraordinary waves in the ionosphere, interaction of waves with absorption taken into account, and limiting polarization of waves emerging from the ionosphere. (W.D.M.)

7883 AEC-tr-3527

INFLUENCE OF TEMPERATURE STRATIFICATION ON HEAT EXCHANGE IN WATER. L. V. Nesina. Translated for Savannah River Lab. from Trudy Glavoni Geofiz. Observatorii im. A. I. Voeĭkova, No. 59, 37-9 (1956). 4p. $1.80(ph), $1.80(mf) JCL or LC.

The temperature distribution in 5 USSR bodies of water was determined to examine the peculiarities of heat exchange in these ponds. Expressions for heat exchange in water are proposed for conditions under which temperature stratification plays a part and those under which stratification is not considered. An approximate formula for calculation of heat exchange in the water of shallow ponds in summer is given. (J.R.D.)

7884 AEC-tr-3553

INVESTIGATIONS ON THE ELECTRICAL CONDUCTIVITY OF SOME BASIC MATERIALS, BONDING AGENTS, AND THEIR COMPOUNDS FOR THE MANUFACTURE OF INSULATING MASSES FOR ELECTRICAL HEATING ELEMENTS. (Untersuchungen über die Elektrische Leitfähigkeit einiger Grundstaffe, Bindemittel und ihrer Mischungen zur Herstellung von Isoliermassen für Elektrische Heizkörper.) Translated for Atomics International from Ber. deut. keram. Ges. 19, 461-9(1938). 19p. (Includes original, 10p.). $3.30 (ph), $2.40(mf) JCL or LC.

Materials used in insulation of electrical heating elements such as magnesium oxide, aluminum oxide, beryllium oxide, zirconium oxide, clay, silicic acid, kaolin, and steatite were investigated. The conductivity of these materials was measured with reference to dependence on temperature and pressure. In addition, like measurements were made for magnesium oxide–beryllium oxide, magnesium oxide–silicic acid, and magnesium oxide–steatite systems. The total error of the measurements was about ± 20%. (J.R.D.)

7885 NP-tr-210

AN IMPORTANT PROBLEM OF MODERN PHYSICS; (EXCITONS IN THE CRYSTAL LATTICE). E. F. Gross. Translated for Lincoln Lab., MIT from Vestnik Akad. Nauk S.S.S.R. 28, No. 10, 11-19(1958). 16p.

Apparently excitons, in addition to electrons, holes and phonons, play an essential part in many physical phenomena occurring in the crystal lattice. Quasi-particles, transporting energy from one place in the crystal to another, from a place where this energy has been generated to the place where it will be liberated, are probably of primary value in such phenomena as the optical spectra of crystals, their electrical and magnetooptic properties, internal photoelectric effect, external photoelectric effect, luminescence. If thermal excitation of excitons in a crystal is possible (in the case of a narrow forbidden band), they can probably play a notable part in the heat conduction phenomena of crystals. It is possible that excitons can play a part also in other phenomena, such as secondary electron emission. (auth)

7886

THE CRYSTAL STRUCTURE OF $NbOCl_3$. Donald E. Sands, Allan Zalkin, and Robert E. Elson (Univ. of California, Livermore). Acta Cryst. 12, 21-3(1959) Jan.

$NbOCl_3$ crystallizes in the tetragonal space group, $P4_2/mnm$. There are four formula units in the unit cell with $a_0 = 10.87$ and $c_0 = 3.96$ A. This compound forms peculiar polymeric chains of $NbOCl_3$ dimers. The dimer has the same shape as the $NbCl_5$ dimer which has been described as two octahedra sharing an edge. These $NbOCl_3$ dimers form infinite linear chains along the c_0 direction through Nb–O–Nb bonds. (auth)

7887

THE CRYSTAL STRUCTURE OF RUTHENOCENE. George L. Hardgrove and David H. Templeton (Univ. of California, Berkeley). Acta Cryst. 12, 28-32(1959) Jan.

Dicyclopentadienylruthenium, or ruthenocene, crystallizes in the orthorhombic space group Pnma with a = 7.13, b = 8.99, c = 12.81 A. There are four $Ru(C_5H_5)_2$ molecules per unit cell. The ruthenium atoms form approximately a face-centered lattice, and the cyclopentadienyl rings lie in an eclipsed configuration with respect to each other about each ruthenium atom. The structure was refined by Fourier and least-squares methods with 791 independent reflections. The ruthenium–carbon distance is 2.21 A, and the carbon–carbon bond distance in the rings averages 1.43 A. (auth)

7888

THE CRYSTAL STRUCTURE OF LiAs. Don T. Cromer (Los Alamos Scientific Lab., N. Mex.). Acta Cryst. 12, 36-41(1959) Jan.

The crystal structure of LiAs has been determined by single-crystal methods. The approximate structure was deduced from photographic data, and a least-squares refinement was made with data obtained with a scintillation counter. LiAs is monoclinic with eight formula units in space group $P2_1/c$. The cell dimensions are a = 5.79 ± 0.01, b = 5.24 ± 0.01, c = 10.70 ± 0.02 A, and $\beta = 117.4 \pm 0.2°$. The arsenic atoms form singly bonded infinite spiral chains parallel to the b axis. The As–As

bonds differ slightly in length and are alternately 2.454 and 2.472 A. The average Li–As distance is 2.78 A. The lithium atoms are in positions defined approximately by a spiral coaxial with the arsenic chains but with a somewhat larger radius and the spiral rotated approximately 90°. Each atom has six neighbors of the other kind at the corners of a deformed octahedron. (auth)

7889

THE CRYSTAL STRUCTURE OF NaSb. Don T. Cromer (Los Alamos Scientific Lab., N. Mex.). Acta Cryst. 12, 41-5(1959) Jan.

The crystal structure of NaSb has been determined by single crystal methods and found to be isostructural with LiAs. The dimensions of the monoclinic cell are $a = 6.80 \pm 0.02$, $b = 6.34 \pm 0.02$, $c = 12.48 \pm 0.04$ A, and $\beta = 117.6 \pm 0.2°$. The parameters were determined by least-squares refinement of the h0l and 0kl zones with all cross-products included. An interesting feature of this structure is that one of the Na–Na distances is 3.44 ± 0.09 A, significantly shorter than in metallic sodium. (auth)

7890

NEGATIVE IONS. G. Tamas. Bull. Inform. sci. et tech. No. 24, 2-19(1958) Dec. (In French)

A survey is made of the problems posed by negative ions. The problem of their stability and the evaluation of electronic affinities are considered, and the theoretical and experimental difficulties are indicated. The various processes for the formation and dissociation of negative ions are discussed, along with the relative importance of each process. 30 references. (auth)

7891

THE NON-EMPIRICAL CALCULATION OF THE FORCE CONSTANT OF THE MOLECULE LiH. Georges Bessis and Savo Bratož. Compt. rend. 247, 2121-3(1958) Dec. 10. (In French)

The force constant for the LiH molecule is calculated by taking into consideration the possible errors introduced by interpolation and by examining the contributions made to the constant by the valence layer and the repulsion terms between the atomic nuclei. The calculation was made in two approximations, approximation of the self-coherent field and approximation of the configuration interaction. (J.S.R.)

7892

STUDY OF THE INFRARED SPECTRUM IN THE REGION OF 3μ OF DIFFERENT SAMPLES OF CLEAR AND NEUTRON IRRADIATED QUARTZ. Armand Hadni, Lucienne Taurel, Michel Paillette, and Ali Lankoande. Compt. rend. 248, 211-13(1959) Jan. 12. (In French)

A description is given of a fine structure in quartz which is variable in different samples and is attributed to impurities or lattice faults. The fine structure is modified by neutron irradiation. (tr-auth)

7893

VERY IONIZED REGIONS OF INTERSTELLAR MATTER. Anne-Marie Rozis-Saulgeot. Compt. rend. 248, 650-3(1959) Feb. 2. (In French)

A parallel is established between the properties of very ionized regions of interstellar matter and the superconductivity properties of metals at very low temperatures. This analogy leads to a new description of certain regions of interstellar matter. (tr-auth)

7894

PRECIPITATION OF HELIUM IN BERYLLIUM OXIDE IRRADIATED BY NEUTRONS. Henri Frisby, Auguste Bisson, and Roger Caillat. Compt. rend. 248, 672-3 (1959) Feb. 2. (In French)

The replicas of fractures obtained on fritted beryllium oxide irradiated with fast neutrons were examined with an electron microscope. After a series of thermal treatments, the formation, magnification, and evolution of blisters in the sample mass were observed. (tr-auth)

7895

ON THE SOLUTION OF UNSTEADY MOTION PROBLEMS IN MAGNETIC HYDRODYNAMICS. O. A. Ladyzhenskaya and V. A. Solonnikov (Steklov Math. Inst. Leningrad Branch of the Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 124, 26-8(1959) Jan. 1. (In Russian)

An analysis was made of the interaction contact between a magnetic field and the viscous, incompressible flow in it. It is shown that it is possible to determine the values v, p, E, and H of the equation for the above conditions. (R.V.J.)

7896

SOLUTIONS OF MAGNETIC GAS-DYNAMIC EQUATIONS FOR ZERO TEMPERATURE GRADIENT. V. P. Korobeinikov and E. V. Ryazanov (Lomonosov Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. 124, 51-2 (1959) Jan. 1. (In Russian)

The condition of adiabatic motion cannot be fulfilled if it is assumed that a strong heat exchange exists between the particles in a gas flow (the plasma in hydrodynamic approximation). Instead of this condition, in describing the processes related to high temperatures and intense heat exchange, it is possible to assume that the temperature in the gas flow does not depend on the geometric coordinate but only on time. Studies were made of the one-dimensional motion of a conducting ideal gas with cylindrical and plane waves; conductivity was taken as infinite and viscosity was not considered. The magnetic field is taken as perpendicular to the gas particle trajectories. In the case of cylindrical waves, the magnetic power lines can be rectangular, parallel to the symmetry axis, concentric spheres with their centers at the symmetry axis, or helical lines. (R.V.J.)

7897

ON EXPERIMENTAL PROCEDURE IN STUDYING SECONDARY PROCESSES INDUCED BY IONS WHEN THE TEMPERATURE OF THE TARGET IS HIGH AND THERMIONIC EMISSION IS PRESENT. U. A. Arifov, A. Kh. Ayukhanov, S. V. Starodubtsev, and Kh. Kh. Khadzhimukhamedov (Inst. of Physics and Tech., Academy of Sciences, Uzbek SSR). Doklady Akad. Nauk S.S.S.R. 124, 60-2(1959) Jan. 1. (In Russian)

An improved binary modulation method was used in the investigation of ion induced secondary processes at elevated temperatures in which the thermoelectric current can control target emission. (R.V.J.)

7898

USE OF THE METHOD OF ADDED VARIABLES IN STATISTICAL PHYSICS. A. Pawlikowski and V. Shchuruvna (Inst. of Physics, Polish Academy of Sciences, Wroclaw). Doklady Akad. Nauk S.S.S.R. 124, 69-71(1959) Jan. 1. (In Russian)

It is shown that statistical sums calculated in Bohm-Pines and Migdal-Galitskii approximations with modi-

fied supplementary conditions produced a true classical expression with $\hbar \to 0$. It is also shown that the supplementary condition modification proposed by H. Kanazawa (Progr. Theoret. Phys. 18, 287 (1957)) is essential. (R.V.J.)

7899

INTENSITY OF A Po–Be NEUTRON SOURCE WITH n–γ COINCIDENCE METHOD. A. Fasana and V. Sangiust (Istituto di Fisica Sperimentale del Politecnico, Milan). Energia nucleare (Milan) 5, 834-8 (1958) Dec.

The early method of producing neutrons with natural α emitters by means of the (α, n) reaction, while inadequate for accurate neutron research, is still of importance in producing a standard neutron flux. For this purpose the intensity of the source must be known with precision. The n-γ coincidence method is applied to the calibration of a Po–Be source. The limitations and advantages of the method are discussed. (auth)

7900

ON THE GREEN FUNCTION METHOD IN THE MULTIELECTRON PROBLEM IN SOLIDS. V. I. Bonch-Bruevich (Lomonosov Moscow State Univ.). Fiz. Metal. i Metalloved. 6, 590-600(1958). (In Russian)

The method of Green's function was used in the analysis of plasma oscillation and screening of the outer field in multielectron systems. The anisotropy of isoenergetic surfaces was considered. The true expressions for plasma spectra and the screening law are obtained by the breaking down mass and polarization operators into bond constant power series. (R.V.J.)

7901

ELECTRON ENERGY IN A NEAR PERIODIC FIELD. A. I. Rezanov (Gor'kii Urals State Univ.). Fiz. Metal i Metalloved. 6, 601-8(1958). (In Russian)

Formulas for the wave function and electron energy in an ionic field configuration corresponding to the near-periodic potential were obtained in a one-dimensional, strongly-bound electron approximation. The energy values form a two-band combination and are determined as statistical averages which can be calculated by using the density distribution function in a non-ideal chain and the inexact potential repetition in shifting to near periods. (tr-auth)

7902

BARIUM TITANATE POLYMORPHOUS CONVERSION AT HIGH TEMPERATURES. I. A. Trifonov (Rostov-on-Don State Univ.). Izvest. Akad. Nauk S.S.S.R. Ser. Fiz. 22, 1462-4(1958) Dec. (In Russian)

The conversion of the hexagonal modification into a perovskite-type structure and the changes in dielectric penetrability were studied. The relationship of seignettoelectric phase concentration to the temperature of the hexagonal specimen during thermal treatment was determined. (R.V.J.)

7903

THE CRYSTALLINE STRUCTURE OF $BaTiO_3$–$LaAlO_3$. I. G. Ismailzade (Inst. of Oil, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R. Ser. Fiz. 22, 1483-4(1958) Dec. (In Russian)

Studies of eleven specimens of $BaTiO_3$, $BaTiO_3$, containing 1, 2.5, 5, 10, 12.5, 15, 25, and 50 mol. % $LaAlO_3$, and $LaAlO_3$ showed that crystallization of solid solutions into perovskite-type structure takes place at 0 to 25 mole % concentrations. At 50 mole % the $LaAlO_3$ turns into a heterogeneous mixture. For 95% $BaTiO_3$–5% $LaAlO_3$ the tetragonal lattice converts into a cubic lattice. (R.V.J.)

7904

HIGH-TEMPERATURE MECHANICAL PROPERTIES OF GRAPHITE. I. CREEP IN COMPRESSION. Paul Wagner and Allen R. Driesner (Los Alamos Scientific Lab., N. Mex.). J. Appl. Phys. 30, 148-51(1959) Feb.

Measurements were made on the steady-state rates of compressive creep of graphite in the temperature range 2270 to 2780°K. Creep to failure was observed to occur in one of two ways; three out of seventeen samples exhibited a third stage of creep before failure occurred, the remaining fourteen samples failed in a manner analogous to that observed for graphite in tension, that is fracture without the appearance of a third stage. All the latter type creep data are correlated by a classical rate equation of the form: rate = $K (\sigma/\sigma_B)$ exp $(-E/RT)$. (auth)

7905

HIGH-TEMPERATURE PROPERTIES OF GRAPHITE. II. CREEP IN TENSION. Paul Wagner, Allen L. Driesner, and Larry A. Haskin (Los Alamos Scientific Lab., N. Mex.). J. Appl. Phys. 30, 152-4(1959) Feb.

Measurements were made on the steady-state creep rates of graphite in tension in the temperature range 2270 to 3270°K. Molded, extruded, and uranium "loaded" graphites were used in the course of investigation. The general characteristics of creep in graphite at high temperatures have been described in the literature and the results presented here covering the range of steady-state creep 10^{-7} to 10^{-4} cm/cm-sec are in accord with published results. In addition, the tensile steady-state creep data are correlated by a classical rate equation of the form, rate = $f(U) (\sigma/\sigma_B)^n$ exp $(-E/RT)$, where f(U) is a function of the uranium concentration in the graphite. (auth)

7906

INVESTIGATIONS OF THE RESEARCH INSTITUTE CONCERNING THE FORMULATION OF A HEAVY CONCRETE THAT IS IMPERVIOUS TO RADIATION. Kunst. Magyar Epitoipar 6, No. 3-4, 126-38(1957). (Translated from Referat. Zhur. Khim. No. 16, 1958, Abstract No. 54788.)

As a protection against radiation from radioactive isotopes, heavy concrete (HC) is used, which is impermeable to high-energy rays. The HC possesses the required protective properties against gamma rays and neutrons because in it coexist atoms of high (Si, Ca) and low (H) numbers. At the present time, two types of HC are in use: those with heavy fillers and protective against gamma rays, and those with high water content and protective against neutrons. The first consists of baryte, magnesite, hematite, and scrap iron. An increase in water content is achieved by addition of magnesium cements and dimonites. Data are furnished on various tests that were conducted on HC in connection with the construction of a new atomic reactor in Hungary. Among them, concretes with volume weight of 3.20 and 4.20 t/m^3 of various compositions were also tested. Data are given on gamma-ray absorption by concretes that are in current use in Hungary.

7907

ROTATIONAL EFFECT ON THE THERMODYNAMIC PROPERTIES OF ISOTOPES. Agnessa Babloyantz (l'Université Libre de Brussels). Mol. Phys. 2, 39-48(1959) Jan.

It is shown that the differences in the thermodynamic properties of HT and D_2 is due to the fact that, for the same total mass, the distribution of mass between the two atoms is not the same. This fact introduces for the heteronuclear molecules a correlation between translational and rotational degrees of freedom. This is a pure quantal effect. A quantum-mechanical perturbation calculation shows that the energy of the ground state is higher for assemblies of heteronuclear molecules than for assemblies of homonuclear ones. On account of this the equation of state of heteronuclear hydrogen molecules is different from that of homonuclear hydrogen molecules. This permits an understanding, for example, of the higher vapor pressure of HT compared to D_2 and the anomalous behavior of HD. (auth)

7908

EFFECT OF RADIATION ON THE BREAKDOWN OF HOMOGENEOUS FIELD AND SPHERE GAPS. K. R. Allen and K. Phillips (Metropolitan-Vickers Electrical Co., Ltd., Manchester, Eng.). Nature 183, 233-5(1959) Jan. 24.

Radiation effects on the breakdown voltage of homogeneous field and sphere gaps were investigated by mounting homogeneous-field electrodes in a glass chamber. The voltage was accurately stabilized and controlled by means of a helical potentiometer. A 0.001-microfarad condenser was charged through a 100-M Ω resistor, which was in turn connected to one electrode by a 10-M Ω resistor. This arrangement ensured that, when a spark occurred in the chamber, the voltage was chopped and the condenser had to recharge before another spark could occur. The number of discharges per minute was counted for different values of applied voltage for electrode gaps of 1 and 2 cm at pressures of 76 cm and 38.8 cm of mercury in air. The source of radiation was 0.1 mg of radium. In all cases there was an increase in the number of sparks per minute when the gap was irradiated, and there were larger differences between the spark counts as the intensity of irradiation was increased. A comparison was made between the performance of sphere and plane electrodes, and the results indicate that the breakdown voltage of a uniform field gap of 1 cm was about 2 per cent less than for the same spacing between 5-cm spheres. The separation of the spheres was reduced to 0.975 cm so that both gaps broke down at the same voltage. The gaps were connected in parallel and placed so that the radium was 30 cm from both. The apparent reduction of the breakdown voltage by irradiation was about 0.1 per cent for the uniform field and about 1 per cent for the spheres. (J.H.M.)

7909

ORIGIN OF THE RADIATION NEAR THE EARTH DISCOVERED BY MEANS OF SATELLITES. T. Gold (Harvard Coll. Observatory, Cambridge, Mass.). Nature 183, 355-8(1959) Feb. 7.

Considerations are given to the origin of the intense flux of penetrating particles found over most of or all regions of the Earth at heights in excess of 600 km. Auroral observation and satellite data are basis for the discussion. Four different modes of motions of the particles are considered, each with a different time scale: (a) the gyration in the geomagnetic field; (b) the quick North-South oscillation along lines of force; (c) the drift in longitude; and (d) the drift and diffusion in height. The influence of solar outbursts on the flux is discussed. (T.B.A.)

7910

GEOPHYSICAL EFFECTS ASSOCIATED WITH HIGH-ALTITUDE EXPLOSIONS. P. J. Kellogg, E. P. Ney, and J. R. Winckler (Univ. of Minnesota, Minneapolis). Nature 183, 358-61(1959) Feb. 7.

Information is presented on some geophysical effects which one would expect to be associated with high-altitude nuclear or chemical explosions. Discussions are included on: the Johnston Island nuclear explosion which was observed in some detail, geophysically, from the Apia Magnetic Observatory; the high-altitude grenade shot at Woomera, Australia, which also seemed to be accompanied by geophysical effects; and the effects which accompany the release of trapped Van Allen particles, as well as effects expected to be associated with the release of additional particles from a nuclear explosion. (J.H.M.)

7911

STORM-TIME INCREASE OF COSMIC-RAY INTENSITY. Sekiko Yoshida (Nagoya Univ., Japan) and Masami Wada (Inst. of Physical and Chemical Research, Tokyo). Nature 183, 381-3(1959) Feb. 7.

During the period of the International Geophysical Year (July 1957-February 1958) there were several occasions in which the intensity of cosmic rays increased by a few per cent. Two typical events, which occurred on September 13, 1957, and February 11, 1958, are described. Observations indicate that the cosmic-ray intensities increased abruptly by about 2 or 3 per cent on a world-wide scale regardless of diurnal variation. Also, it was found that the increase in intensity coincided with the severest phase of magnetic storms. (J.H.M.)

7912

ORIGIN OF UPPER-ATMOSPHERE LITHIUM ATOMS RESPONSIBLE FOR THE NEW TWILIGHT AIRGLOW AT 6708 A. D. R. Barber (Univ. of Exeter, Sidmouth, Eng.). Nature 183, 384(1959) Feb. 7.

Arguments are presented on the origin of the upper-atmosphere lithium atoms responsible for the twilight airglow observed in October 1957 and again in August-September 1958. Two origins were considered: meteoritic and high-altitude nuclear explosions. The facts indicate that the lithium airglow emission observed on these dates was man-made, and thus unrelated to the passage of meteoritic dust through the Earth's upper atmosphere. (J.H.M.)

7913

WIGNER ENERGY STORAGE, ITS RELATION TO REACTOR DESIGN. P. J. Grant (General Electric Co., Ltd.). Nuclear Eng. 4, 69-72(1959) Feb.

The phenomenon of Wigner energy storage in graphite is considered. Annealing problems are discussed, together with possibilities of avoiding the necessity for annealing by operating the graphite at higher temperatures. (auth)

7914

EVALUATION OF SLATER INTEGRALS WITH HARMONIC OSCILLATOR WAVE FUNCTIONS. Kenneth W. Ford (Los Alamos Scientific Lab., N. Mex.) and E. J. Konopinski (Indiana Univ., Bloomington). Nuclear Phys. 9, 218-24(1958) Dec. (1).

Formulas are given which make the evaluation of the expansion coefficients needed in the Talmi method of nuclear spectroscopy simpler than heretofore. For the case of a gaussian two-body potential, a formula is given which makes possible the direct evaluation of

Slater integrals without recourse to the Talmi expansion. (auth)

7915

AN INVESTIGATION ON PLASMAS IN EXTERNAL MAGNETIC FIELDS. II. VARYING FIELDS. G. Schmidt (Israel Inst. of Tech., Haifa). Nuovo cimento (10) 10, 659-74(1958) Nov. 16.

The behavior of a plasma placed in a varying external magnetic field is investigated considering two limiting cases: (1) the ideal hydromagnetic ($\sigma \to \infty$); (2) the collisionless one. Restricting the calculations to general cylindrical geometries ($\partial/\partial z = 0$) and quasi-stationary processes, a complete set of plasma equations is obtained for both cases. These include among others equations of state also for the tenuous plasma. There is a close resemblance between the two sets of equations referring to completely different physical conditions. The equations can be readily solved to express every macroscopic plasma quantity in terms of the external magnetic field strength. The extension of the considerations to non-quasi-stationary processes is briefly depicted. It leads to a phenomenon which suggests new ways for the increase of plasma temperatures. (auth)

7916

SUPRATHERMAL PARTICLES. II. E. N. Parker and D. A. Tidman (Univ. of Chicago). Phys. Rev. 112, 1048-51(1958) Nov. 15.

More refined models for magnetic fields in plasma are considered, and experiments to be done to study this phenomenon are suggested. (auth)

7917

BEAM-PLASMA INTERACTION. D. W. Mahaffey, G. McCullagh, and K. G. Emeleus (Queen's Univ., Belfast). Phys. Rev. 112, 1052(1958) Nov. 15.

Measurements were made of plasma electron concentration and oscillation intensity through some inhomogeneous low-pressure hot-cathode discharges traversed by electron beams. A strong tendency was found for oscillations to grow in amplitude when a beam moves down a plasma concentration gradient, and to die out when a beam moves up a gradient. (auth)

7918

COLLISIONS OF ELECTRONS WITH HYDROGEN ATOMS. I. IONIZATION. Wade L. Fite and R. T. Brackmann (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Rev. 112, 1141-51 (1958) Nov. 15.

The cross section for ionization of the hydrogen atom on electron impact was measured as a function of electron energy. A modulated beam of atoms and molecules in varying proportions, taken from a furnace, is crossed by a d-c electron beam, and the positive ions formed are taken into a mass spectrometer. By using such modulation techniques, the ions formed by ionization of the beam are distinguished from the much larger number of ions formed by collisions of electrons with the residual gas in the vacuum chamber. From the study of the mass-spectrometer peak strengths as a function of temperature with constant gas flow, the ratio of the cross sections for ionization of the atom and the molecule is directly determined. The absolute atomic cross sections, determined by multiplying this ratio by the known molecular cross sections, are cross-checked by taking relative cross sections for the atom. Complete agreement with the first Born approximation is found only above about 250 ev. Deviations of experiment from theory at lower energies are as predicted qualitatively by theory. (auth)

7919

COLLISIONS OF ELECTRONS WITH HYDROGEN ATOMS. II. EXCITATION OF LYMAN-ALPHA RADIATION. Wade L. Fite and R. T. Brackmann (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Rev. 112, 1151-6(1958) Nov. 15.

The cross section for excitation of Lyman-alpha radiation in electron-hydrogen atom collisions was measured as a function of electron energy. The measurement is made by observing Lyman-alpha photons with an iodine-vapor-filled photon counter. A relative-cross-section curve is normalized to fit the Born approximation for high electron energies. The experiment utilizes a 100-cps-modulated atomic beam whose purity in hydrogen-atom content is determined by ionization and mass analysis. A d-c electron beam crosses the modulated ground-state atomic beam. The photon counter, which looks at the interaction region, has its output passed through a tuned amplifier and phase-sensitive detection system. Although this treatment of the counter output as an a-c current (in which the quantum of charge is that of a Geiger-Mueller pulse) introduces some unique noise problems, it satisfactorily separates the photons which arise from the interaction under study from those which arise from other processes (e.g., electron collisions with the residual gas in the high-vacuum chamber). Some implications of the measured excitation cross section upon scattering theory are discussed. (auth)

7920

COLLISIONS OF ELECTRONS WITH HYDROGEN ATOMS. III. ELASTIC SCATTERING. R. T. Brackmann (General Atomic Div., General Dynamics Corp., San Diego, Calif.) and Roy H. Neynaber (Convair Div., General Dynamics Corp., San Diego, Calif.). Phys. Rev. 112, 1157-61(1958) Nov. 15.

The cross section for elastic scattering of electrons of less than 10-ev energy by free hydrogen atoms was measured. The experimental approach was similar to that used by Bederson, Malamud, and Hammer in that a d-c electron beam crossed an atomic hydrogen beam, which was chopped at a low frequency, and the signal was derived from the electrons scattered by the particles in the neutral beam. The electrons scattered by the beam were identified by their signal's appearing at the modulation frequency and at a specified phase. Direct measurements of the ratio of cross sections of the hydrogen atom and the molecule were made, and absolute values for the atomic cross section were obtained from knowledge of the absolute molecular cross section. The experimental results agree with theory. (auth)

7921

CHARGE EXCHANGE IN PROTON-HYDROGEN-ATOM COLLISIONS. Wade L. Fite, R. Theodore Brackmann, and William R. Snow (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Rev. 112, 1161-9(1958) Nov. 15.

The charge-exchange cross sections for the reactions $p + H \to H + p$, and $H_2^+ + H \to H_2 + p$ have been examined over the energy range 200 to 14,000 ev. In the experiment a d-c fast-ion beam crossed a slow atomic hydrogen beam which was chopped at 100 cps. The desired signal thus was separable from the much larger signal

arising from interaction of the ions with the residual gas in the vacuum chamber, because the signal arising from the interaction of the two beams occurred at the chopping frequency and in a specified phase. The signals used were the saturated slow-ion currents, recorded at a detector which did not discriminate the ion mass, and the slow-ion currents after mass analysis. The measured values at high energies agree very satisfactorily with the Born approximation calculations by Bates and Dalgarno and, at low energies, with calculations by Dalgarno and Yadav using the method of perturbed stationary states. Experimental comparison of cross sections for proton and deuteron collisions is presented. (auth)

7922

K SERIES X-RAY WAVE LENGTHS IN RARE EARTH ELEMENTS. E. L. Chupp, J. W. M. Du Mond, et al. (Univ. of California, Livermore). Phys. Rev. 112, 1183-6(1958) Nov. 15.

The K-series x-rays in ten rare earth elements were studied with a two-meter-radius bent-quartz-crystal spectrograph. The 3.7-Mev proton beam of the A-48 accelerator (UCRL, Livermore) was used to produce the atomic excitations. The wavelengths obtained for the $K_{\alpha 1}$, $K_{\alpha 2}$, $K_{\beta 3}$, and $K_{\beta 1}$ lines are compared with previous wavelength measurements. Two weaker transitions, $K_{\beta 5}$ and $KO_{II}O_{III}$ were also observed and the energies are compared with energies obtained from tables of known atomic energy levels. (auth)

7923

LOW-TEMPERATURE BEHAVIOR OF A DILUTE BOSE SYSTEM OF HARD SPHERES. I. EQUILIBRIUM PROPERTIES. T. D. Lee and C. N. Yang (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 112, 1419-29 (1958) Dec. 1.

By a generalization of the method used in a previous paper the distribution of energy levels of a dilute Bose system of hard spheres is found. These energy levels are then used to compute the statistical properties for the system. A phase transition is found, and the transition point is calculated to the lowest order of α, the diameter of the hard spheres. Furthermore, the thermodynamical functions of the system in both the gas phase and the degenerate phase are obtained, provided $(\alpha/\lambda) \ll 1$ and $\rho\alpha^3 \ll 1$, where λ is the thermal wavelength and ρ is the particle density. (auth)

7924

CONDUCTIVITY OF PLASMAS TO MICROWAVES. Edward A. Desloge, Steven W. Matthysse, and Henry Margenau (Yale Univ., New Haven). Phys. Rev. 112, 1437-40(1958) Dec. 1.

If one assumes that the effect of an alternating electric field on an electron in a slightly ionized gas is on the average an addition, in the direction of the field, of a velocity component, the magnitude of which is dependent on the speed of the electron, then it is possible to derive very simply the expression for conductivity obtained earlier by Margenau. In addition an alternative expression is proposed which is of interest because it avoids difficulties with negative conductivities encountered by Margenau's formula. (auth)

7925

MICROWAVE PROPAGATION IN HOT MAGNETOPLASMAS. J. E. Drummond (Stanford Research Inst., Menlo Park, Calif.). Phys. Rev. 112, 1460-4(1958) Dec. 1.

The indices of refraction of circularly polarized microwave signals propagating along the magnetic field direction within a high-temperature ionized gas are computed by use of a new conductivity tensor. It is found that phase changes and Landau diffusion damping resulting from electron drift become important for certain ranges of the parameters. These effects are enhanced by the resonance that occurs near the electron-cyclotron frequency. The refractive indices depend sensitively upon electron density and temperature. (auth)

7926

THERMAL EXCITATIONS IN LIQUID He^3. Louis Goldstein (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 112, 1465-82(1958) Dec. 1.

Using recently obtained data on various thermal properties of liquid He^3, the constant-volume heat capacity of the saturated liquid was evaluated. This elementary heat capacity $C_v(T)$ was found to exhibit at least three inflection points over the temperature interval extending to the critical temperature. Of these, the one at the lowest temperature was shown to originate with the partial heat capacity of spin disorder. The inflection point at the approach of the critical temperature T_c is imposed by the thermodynamic result that $C_v(T)$ should reach its finite limit $C_v(T_c)$ from below with positively infinite first and second temperature derivatives. The laws governing the pressure dependence of the partial spin heat capacity over the liquid region of the He^3 phase diagram were deduced. The remarkable pressure effects displayed by the spin system of liquid He^3 through its heat capacity may be expected to manifest themselves through the observable pressure dependence of the total liquid heat capacity at low enough temperatures where the spin heat capacity is dominant. A purely heuristic and indirect approach toward the problem of the existence of phonon type of partial excitations in liquid He^3 yields a negative answer, without, however, a definite exclusion of such symmetrical excitations in this antisymmetric liquid. (auth)

7927

VOLUME ANOMALY OF LIQUID He^3 ARISING FROM ITS NUCLEAR SPIN SYSTEM. Louis Goldstein (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 112, 1483-7(1958) Dec. 1.

The anomalous volume expansion coefficient of liquid He^3 derived in a previous work through a discussion of its nuclear spin system is shown to be describable quantitatively within the statistical thermodynamic formalism attached to its nuclear spin degrees of freedom. The theory predicts, through the large partial negative spin expansion coefficient, a volume minimum or a density maximum of saturated liquid He^3 subject to the volume behavior determined by its non-spin degrees of freedom. The temperature at which the density maximum should occur is higher than about 0.2°K. At this temperature, or very close to it, the negative spin expansion coefficient has a sharp minimum and the total liquid density is expected to have an inflection point in the density-temperature representative plane. Since the whole anomaly depends directly on the liquid compressibility, it should be most pronounced in the saturated liquid and should decrease under the application of external pressure. (auth)

7928

TRANSVERSE PLASMA WAVES AND PLASMA VOR-

TICES. O. Buneman (Stanford Univ., Calif.). Phys. Rev. 112, 1504-12(1958) Dec. 1.

Plasmas at high-electron temperatures can carry transverse waves in which self-magnetic fields and relativistic effects become important. The relativistic perturbation equations for an isotropic uniform plasma are solved as an initial-value problem, i.e., by Laplace transformation, and the propagation or dispersal of both longitudinal and transverse perturbations is calculated. In both cases transients occur which have a continuous frequency spectrum. While transverse perturbations also yield pure persistent waves (with phase velocity exceeding that of light) of all wavelengths, longitudinal perturbations of very short wavelength will not be propagated as pure waves but will die out eventually with only longer wavelengths persisting. The transverse plasma perturbations discussed are nonvortical and the dispersal of vortices is covered by a separate discussion. The vortices do not give rise to a new mode of propagation of perturbations. (auth)

7929

ISOTOPE EFFECT ON THE SUPERCONDUCTING TRANSITION IN LEAD. R. R. Hake, D. E. Mapother, and D. L. Decker (Univ. of Illinois, Urbana). Phys. Rev. 112, 1522-32(1958) Dec. 1.

Observations of the difference in critical fields of superconducting Pb specimens of different isotopic mass are described. Measurements are made using the Meissner effect and a ballistic induction method in the range from 7.2 to about 1.4°K. The results near T_c verify the theoretical prediction that $T_c = \text{const} \times M^p$, where M is the average isotopic mass, and yield a value of $p = -0.501 \pm 0.013$. The measurements at lower temperatures are inconclusive in their implications for the isotope effect, since all specimens measured exhibit large deviations from the predictions of the similarity principle. The deviations are apparently not related to the isotopic mass of the specimens. The agency responsible for the observed deviations has not been isolated, but it is believed that the anomalous H_c values are characteristic of thermodynamically irreversible transitions. Thus the present results are not believed to constitute genuine evidence of a deviation from the similarity principle. (auth)

7930

THEORY OF SOLID Ne, A, Kr, AND Xe AT 0°K. Newton Bernardes (Washington Univ., St. Louis). Phys. Rev. 112, 1534-9(1958) Dec. 1.

A quantum-mechanical variational technique is applied to an Einstein model of a solid, and the heats of sublimation and equations of state of solid Ne, Ar, Kr, and Xe are calculated at 0°K. Mie-Lennard-Jones 6-12 potentials appropriate to the gas-phase data are used throughout, and the importance of quantum-mechanical effects is discussed; in general, good agreement with experiment is obtained. From the theoretical zero-point energies equivalent Debye temperatures, θ, are calculated, and from the dependence of these θ on volume, Grüneisen constants are computed in good agreement with experiment. Theoretical compressibility curves (at 0°K) are presented, and compared with the available experimental data; in the case of Ne, the only substance for which high-pressure data are available, the agreement is rather good up to 20 k atmos. (auth)

7931

MAGNETIC MOMENT OF HELIUM IN ITS $^3S_1$ METASTABLE STATE. C. W. Drake, V. W. Hughes, A. Lurio, and J. A. White (Yale Univ., New Haven). Phys. Rev. 112, 1627-36(1958) Dec. 1.

The ratio of the electronic g_J value of He in its 1s2s, $^3S_1$ metastable state to the g_J of H in its ground state was redetermined by the atomic beam magnetic resonance method using separated oscillating fields. At magnetic fields of about 540 and 575 gauss the transitions $\Delta m = \pm 1, \pm 2$ in He and $(F,m) = (1,0) \rightleftharpoons (1,-1)$ in H are observed at frequencies of approximately 1570 Mc/sec and 1140 Mc/sec, respectively. The natural line shapes for the separated oscillating fields method are obtained with spacings between the oscillating fields of both 4.2 cm and 2.2 cm. The experimental result is $g_J(\text{He},{}^3S_1)/g_J(\text{H},{}^2S_{1/2})|_{exp} = 1 - (23.3 \pm 0.8) \times 10^{-6}$, which agrees with an earlier measurement having an accuracy of 16 ppm, and also with the theoretical value $g_J(\text{He},{}^3S_1)/g_J(\text{H},{}^2S_{1/2})|_{theor} = 1 - (23.3 \pm 1.0) \times 10^{-6}$ obtained by Perl and Hughes, which was computed from the Breit equation for He with the addition of a term to represent the interaction of the anomalous spin magnetic moment of each electron with the external magnetic field. (auth)

7932

EFFECTS OF AN ELECTRIC DIPOLE MOMENT OF THE ELECTRON ON THE HYDROGEN ENERGY LEVELS. G. Feinberg (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 112, 1637-42(1958) Dec. 1.

The bound states in a Coulomb field of a charged, spin ½, particle with an electric dipole moment are obtained. The nonrelativistic Schrödinger equation for such a particle is solved in closed form. The wave functions are generalizations of the Coulomb wave functions, involving Laguerre polynomials of nonintegral upper index. The accidental degeneracies of the Coulomb energy levels are removed by the dipole interaction. In particular, there will be an additional contribution to the splitting between the $2S_{1/2}$ and $2P_{1/2}$ states coming from the dipole moment. By requiring that this extra energy shift should not destroy the agreement between the theoretical and experimental values of the Lamb shift, it is found that the dipole moment of the electron must be less than 10^{-13} cm times the electron charge. Other effects of the dipole moment on the hydrogen energy levels are discussed. (auth)

7933

OBSERVATIONS OF HYDROGEN VIBRATION FREQUENCIES IN PHOSPHATES BY MEANS OF INELASTIC SCATTERING OF COLD NEUTRONS. I. Pelah, I. Lefkowitz, W. Kley, and E. Tunkelo (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters 2, 94-5(1959) Feb. 1.

Inelastic neutron scattering methods have proven successful in measuring the hydrogen vibrations in several hydrides. Using these techniques, measurements of the time-of-flight spectra of the scattered neutrons were made on K_2PO_4, K_2HPO_4, and KH_2PO_4 at room temperature. (W.D.M.)

7934

PHOTOGRAPHY OF COSMIC RAYS IN A LUMINESCENT CHAMBER. Martin L. Perl and Lawrence W. Jones (Univ. of Michigan, Ann Arbor). Phys. Rev. Letters 2, 116-17(1959) Feb. 1.

A method is described for photographing minimum-ionizing cosmic rays in a sodium iodide crystal using available electronic and optical components. With modifications the apparatus can be used for luminescent

chamber experiments in high-energy particle physics. The system consists of photomultiplier, NaI crystal, and three image intensifier tubes optically coupled to each other and to the crystal and film with refractive lenses. (W.D.M.)

7935

SHOCK WAVES. K. P. Stanyukovich and G. S. Golitsyn. Priroda 47, No. 12, 33-8(1958) Dec. (In Russian)

A review is given of the origin, development, and various phenomena of shock waves. (R.V.J.)

7936

THE EXPLORATION OF THE UPPER ATMOSPHERE BY MEANS OF THE THIRD SOVIET ARTIFICIAL EARTH SATELLITE. V. I. Krasovskii. Priroda 47, No. 12, 71-8(1958) Dec. (In Russian)

Descriptions are given of the instrumentation placed in the third satellite and the data recorded by these instruments. It was found that at 260 km the atmospheric density is 10^{-13} g/cm^3 and at 355 km it is 9×10^{-15} g/cm^3. The electron density at 475 km is 1.0×10^6 per/cm^3, while at 290 km it is 1.8×10^6. On May 15, 1958, 5 to 6 hours after mid-day, at elevation 795 km and at mean longitudes, the negative potential of the satellite front was equal to 6.4 v; such a potential was possible for electron temperatures not less than 15,000°K. The concentrations of positive ions was 1.8×10^5 per/cm^3. A great deal of data was obtained on hard electrons in the upper layers of the atmosphere. Apparatuses for recording collisions with micrometeors measured pulses in the range 10^{-4} to 10^{-3} g/cm/sec. The transducers used were capable of measuring particles with a mass of 10^{-9} g and over. Nearly 50 collisions per m^2/sec were observed at 140 to 300 km. The data on the deflections of the magnetic field from the normal state should prove of value in studies of ionospheric currents. (R.V.J.)

7937

ON THE UTILIZATION OF A HIGH-CURRENT PULSE DISCHARGE IN PROTON SOURCES. M. D. Gabovich, O. F. Nemetz, and Z. P. Fedorus (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Ukrain. Fiz. Zhur. 3, 104-11(1958) Jan.-Feb. (In Russian)

A pulsed arc arising from the Penning-Keller discharge was studied as a possible pulse high-current proton source. At discharge currents up to 200 a the extracted ion currents exceed 30 ma and the extracted ion current density at the exit hole exceeds 4 a/cm^2. In spite of the difficulties encountered it is possible to obtain reproducible slightly modulated rectangular ion pulses. The increase of proton contents with arc current was established for the first time (in 1950) and amounts to as much as 85 to 90% in a metal chamber. A device for pulsed hydrogen inlet is introduced. Attention is drawn to the use in this source of a developed surface of penetrating plasma as the emission zone, which makes it possible to obtain high currents at relatively weak electrical fields and a small exit hole. The penetrating plasma was used recently for extracting and focusing very high current ion beams. (tr-auth)

7938

FORBIDDEN LINES IN ATOMIC SPECTRA. L. A. Borisoglebskii. Uspekhi Fiz. Nauk 66, 603-52(1958) Dec. (In Russian)

A survey is made of theoretical and experimental studies of forbidden lines in atomic spectra. General regularities and classifications of spontaneous forbidden lines, forbidden emissions of celestial bodies, and lines impelled by various fields are discussed. The problems of producing forbidden lines under laboratory conditions and a series of unsolved important problems related to forbidden atomic emissions are analyzed. 166 references. (R.V.J.)

7939

DETERMINATION OF THE NEUTRON EMISSION OF A NEUTRON SOURCE. Peter Wunderer (Technischen Hochschule, Munich). Z. angew. Phys. 10, 537-46(1958) Dec. (In German)

The absolute neutron emission of a 100 mc Ra-α-Be and a 25 c Po-α-Be source was measured. The emitted neutron was moderated and absorbed in a manganese sulfate solution. From a part of the solution the manganese was precipitated, and after drying the activity was measured with calibrated γ counters. With a known effective cross section for hydrogen and manganese, the source emission can be measured. The calibration of the counter was obtained with a Mn^{56} preparation from a solution whose activity per volume unit was determined with a 4 π counter. The effective cross section ratio σ_H/σ_{Mn} was determined by measurement of the thermal neutron distribution in water and manganese sulfate solution. The resonance capture of neutrons by manganese was ascertained by the determination of the flux distribution of gold resonance neutrons in water and manganese sulfate solution. With consideration of the absorption of neutrons in sulfur, oxygen, and the source material, small corrections were made. The low number of neutrons escaping from the solution was also allowed for by a correction. (tr-auth)

7940

ENERGY DISTRIBUTION OF HYDROGEN IONS FROM A HIGH FREQUENCY ION SOURCE. Günter Forst (Univ. of Berlin). Z. angew. Phys. 10, 546-51(1958) Dec. (In German)

The energy distribution of the hydrogen ions from a high-frequency ion source was investigated by means of an opposing field lens with and without magnetic separation of the various ion masses. The energy resolution of the opposing field lens, according to the grid selection, is up to 10,000. The energy distribution of the hydrogen ion is independent of the nozzle form and the purity of the nozzle surface, but is dependent on the size of the limiting resistance, the probe voltage, the hydrogen pressure in the discharge tube, and the transmission power. The integral energy distribution of the hydrogen ions consists of a principal stage and one or two intermediate stages. The ions forming the principal stage possess an average energy which corresponds in general to the probe voltage used. The intermediate stages are formed by ions of lower energy. While the principal stage is around 70 ev wide, the width of the intermediate stages is over 1000 ev. The height of the principal stage with respect to the intermediate stages is then greatest when the ionic current is the greatest. A beam of ions with energy as equal as possible is adjusted so that the probe voltage, the hydrogen pressure in the discharge tube, or the transmission power is regulated at the maximum ionic current. The results of the experimental determination of the energy distribution of hydrogen ions will be published later. (tr-auth)

7941

THE BAND SPECTRUM OF THALLIUM DEUTERIDES. H. Neuhaus and V. Muld (Univ. of Stockholm). Z. Physik 153, 412-22(1959). (In German)

The band spectrum of TlH molecules observed earlier by Grundström and Valberg (Z. Physik 108, 326(1938)) was investigated with high-resolution Hulthen immersion gratings. In a like manner the band spectrum (4000 to 6100 A) of TlD was obtained for the first time and analyzed. The TlH and TlD bands investigated were explained as a $^3\Pi_0 - X^1\ \Sigma^+$ transition by a comparison of the spectra of both molecules. The vibration difference of the $^3\Pi_0$ terms shows an anomalous pattern. No hyperfine structure of the band lines was observed. The predissociation effect, which is shown in the broadening of the lines with increasing J value, is discussed. The calculation of the wave number of the unknown band lines was carried out. (tr-auth)

7942

PROCEEDINGS OF THE 1957 CRYOGENIC ENGINEERING CONFERENCE, AUGUST 19-21, 1957, NATIONAL BUREAU OF STANDARDS, BOULDER, COLORADO. K. D. Timmerhaus, ed. Boulder, University of Colorado, 1958. 430p.

Forty-four papers are presented relating to cryogenic processes, applications, equipment, and properties. (W.L.H.)

7943

MICROWAVE INVESTIGATION OF DISINTEGRATING GASEOUS DISCHARGE PLASMAS. Hendrik Jan Iskam. Thesis, State Univ. of Utrecht, 1957.

The measurements were carried out in the rare gases and concern the investigation of the disappearance of electrons from a disintegrating gaseous discharge plasma. The experimental method employed for the determination of the electron density during the afterglow consisted in measuring the shift of the resonance frequency of a microwave cavity attributed to the presence of the electron gas. The method is based on the interaction of a plasma with electromagnetic fields of very high frequencies and requires that the conductivity of a plasma at high frequencies be known. After switching off the excitation of a gas discharge, the electrons may disappear from the plasma by diffusion to the walls of the container. The influence of these processes on the curve representing the electron density versus time is discussed, and formulas are presented for a single loss process and for two such processes combined. The connection between the conductivity of plasma and the properties of the microwave cavity are discussed and the resulting shift of resonance frequency computed. (A.C.)

7944

IONIZATION OF ARGON BY ALPHA PARTICLES OF VARIOUS ENERGIES. Gerrit Pieter Brouwer. Thesis, University of Amsterdam, 1958. (In Dutch)

The ionization-energy curve for α particles in argon was experimentally determined for alpha energies between 0.249 and 6.347 Mev. The methods used for the measurement of the energies and the ionization are described in detail. The results of the investigation are tabulated and show that the straight line through the measured points above 4 Mev intersects the energy axis at 375 ± 30 kev. The curve of the differential energy per ion pair as a function of the alpha energy has a maximum at 2 Mev and approaches the ionization potential of argon, 15.8 ev, as the energy of the particle approaches zero. (J.S.R.)

7945

MAGNETOHYDRODYNAMICS. T. G. Cowling. New York, Interscience Publishers, Inc., 1957. 121p.

The emphasis is on the geophysical and astronomical applications of magnetohydrodynamics. Both gases and fluids are treated with the assumption that an ionized gas is a continuous fluid. Some knowledge of Maxwell's equations and of the basic equations of hydrodynamics is assumed in the reader. Vector methods are freely used, including transformations involving the curl and divergence of vectors, and expressions in terms of cylindrical polar coördinates. (W.D.M.)

Elementary Particles

7946 CERN-59-3

European Organization for Nuclear Research, Geneva. MULTIPLE MESON PRODUCTION FROM p-p COLLISIONS AT 2.75 GeV ACCORDING TO A STATISTICAL THEORY. F. Cerulus and R. Hagedorn. Dec. 15, 1958. 35p.

The multiple meson production in p-p collisions at 2.75 Bev is calculated using a Fermi-type statistical theory. Conservation of isospin, energy, and momentum as well as the indistinguishability of like particles are taken into account. The phase-space integrals are evaluated by a Monte-Carlo method from their exact expression. Final state π-N interactions are introduced by assuming the production of isobars in the collision. With this feature and the conventional interaction volume agreement with the experimentally measured multiplicities is good. The ratios of the charge-states for the different multiplicities are further given, as well as the spectra of the positive, negative, and neutral pions. (auth)

7947 CERN-59-5

European Organization for Nuclear Research, Geneva. ATTEMPT TO DETERMINE MUON HELICITY BY MEASURING POLARIZATION OF B^{12} FORMED IN THE REACTION $C^{12} + \mu^- \rightarrow B^{12} + \nu$. A. Lundby, R. Meunier, J. P. Stroot, J. D. Teja, J. Fischer, and J. O. Burgman. Feb. 2, 1959. 8p.

An experiment to measure polarization of B^{12} formed in the reaction $C^{12} + \mu^- \rightarrow B^{12} + \nu$ in order to determine the muon helicity is described. Muons of 175 Mev/c momentum stopping in a directional Cherenkov counter filled with hexane were used. The decay electrons from B^{12} were recorded between the cyclotron beam pulses. (W.D.M.)

7948 NP-7079

Princeton Univ., N. J. Palmer Physical Lab. and Princeton Univ., N. J. Naval Ordnance Lab. THE DETERMINATION OF THE SIGN OF THE ASYMMETRY PARAMETER IN Λ° DECAY FROM THE SCATTERING OF THE DECAY PROTON. Technical Report No. 21. T. Bowen, C. R. Sun, and A. E. Werbrouck. Dec. 3, 1958. 18p. Contract Nonr-1858(06).

A statistical method is presented whereby the information provided by a small number of nuclear scatters of Λ° decay protons can be used to determine the sign of the asymmetry parameter due to parity nonconservation in Λ° decay. The analysis is applied to twenty-one proton scatters of Λ° hyperons decaying in the Princeton multiplate cloud chamber. Because the asymmetry to be expected in each observed nuclear scatter is small, the data do not yield a statistically significant result. However, if each experimenter would follow a similar procedure with his data, it should be possible to combine results to determine the sign with a high degree of certainty. (auth)

7949 NP-7306

Princeton Univ., N. J. Palmer Physical Lab. and Princeton Univ., N. J. Naval Ordnance Lab.

STRANGE PARTICLE PRODUCTION IN COMPLEX NUCLEI. Technical Report No. 22 [on] COSMIC RAY AND ELEMENTARY PARTICLES GROUP. Albert Eugene Werbrouck. Feb. 20, 1959. 99p. Contract Nonr-1858(06).

Strange particle production by high-energy pions and protons bombarding carbon, iron, and lead nuclei in a multiplate cloud chamber was investigated. This choice of targets provided an opportunity to compare the effects of multistage processes which are sensitive to nuclear radius. The two stage process that originally motivated the experiment was the indirect production of strange particles by pions in turn produced by a nucleon incident on the same nucleus. Early indications of very low direct production of strange particles in p-p collisions led to the belief that a large fraction of the production in p-nucleus collisions was through the indirect process. The value for this fraction in lead is ~⅔. A K-pair production by protons comparable to the direct production of hyperon-K meson pairs by protons was also observed. To have a quantitative knowledge of the strange particle production by a known pion beam in nuclear matter, the same targets to 1.5 Bev π^- mesons as well as 2.8 Bev protons were exposed. This data also yielded interesting comparisons on the effects of other multistage processes, namely the interactions of the strange particles after production. The cross section for the conversion of charged hyperons into neutral hyperons in nuclear interactions seemed to be bigger than geometric. The strange particle production by the pion beam was predominantly direct as shown by a comparison with the bubble chamber studies of π-nucleon collisions. Total cross sections for strange particle production and distributions in lab angle and energy are presented for the observed strange particles. The multiplate chamber and its auxiliary equipment are described. An improvement in the stability of the cosmotron proton blow-up beam is explained. As part of the analysis of individual events, a least squares fit of measured points to a decay plane is presented in a form suitable for use with a digital computer. (For preceding report see NP-7079.) (auth)

7950 CEA-tr-I17

LES MESURES EN COINCIDENCE EN PHYSIQUE NUCLÉAIRE. (Coincidence Measurements in Nuclear Physics.) E. Minardi. Translated into French by G. Alessandri from report CISE-26, [195?]. 26p.

A survey is presented on the techniques and uses of coincidence measurements in nuclear physics. The general properties of the beta spectra of radioisotopes are discussed. The techniques used in the measurement of beta and gamma energies with Geiger counters are described, and the techniques of coincidence measurements are reviewed. The efficiency of Geiger counters for gamma radiation can be determined by coincidence measurements. The use of coincidence measurements for the determination of decay schemes is considered. 73 references. (J.S.R.)

7951 CEA-tr-R-476

SUR LE PROBLEME DE LA THERMALISATION DES NEUTRONS DANS UN MILIEU A TEMPERATURE VARIABLE. (The Problem of the Thermalization of Neutrons in a Medium with Variable Temperature.) G. A. Batzh (Batj). Translated into French by B. Vinogradov, Sept. 16, 1958. 5p.

The method of moments is used to solve the equations describing the thermalization of neutrons in a medium with variable temperature. (J.S.R.)

7952

STUDY OF THE ELASTIC SCATTERING OF 38-Mev ALPHA PARTICLES BY F^{19}. J. Catalá, L. Miralles, et al. (Instituto de Optica "Daza de Valdes," Valencia.) Anales real soc. españ. fis. y quim. (Madrid) Ser. A 54, 255-62(1958) Sept.-Oct. (In Spanish)

The elastic scattering of 38-Mev alpha particles from the $F^{19}(\alpha,\alpha)F^{19}$ reaction was studied by the photographic method. The analysis of the relative positions of the angular distribution maxima, through the theory of the light diffraction by an opaque disk, yields a value for the interaction radius of $(5.09 \pm 0.30) \times 10^{-13}$ cm. (auth)

7953

PION-NUCLEON PHASE SHIFTS FOR INTERMEDIATE ENERGIES. H. Y. Chiu and E. L. Lomon (Cornell Univ., Ithaca, N. Y.). Ann. Phys. (N. Y.) 6, 50-69(1959) Jan.

The pion-nucleon scattering at 150, 170, 220, and 307 Mev is analyzed into S and P state phase shifts. The best Fermi type solutions are found, and the statistically plausible ranges of the phase shifts are obtained. At 150 and 170 Mev it is found that $(\delta_{13} - \delta_{31}) > 3°$. At 220 and 307 Mev three optimal Fermi type solutions are found, one corresponding to a continuation of the lower energy solutions. The other two solutions are not both continuous with those below resonance nor do they satisfy both the available recoil proton polarization data and the dispersion relations. Data at other energies are consistent with the interpolated or extrapolated phase shifts. The continuous set of phase shifts is consistent with a k^3 variation of the small p wave phase shifts. δ_1 shows a tendency to increase less than linearly by 220 Mev. A Chew-Low plot of δ_{33} fits a straight line up to 220 Mev with $f^2 = 0.08$ and the resonance at 195 ± 4 Mev. (auth)

7954

ABSOLUTE ELECTRON-NUCLEAR DIFFERENTIAL SCATTERING CROSS SECTIONS AT 1.00 Mev, 1.75 Mev, AND 2.50 Mev. I. V. Spiegel, Jr., T. F. Ruane, D. J. Anthony, B. Waldman, and W. C. Miller (Univ. of Notre Dame, Ind.). Ann. Phys. (N. Y.) 6, 70-85 (1959) Jan.

Monoergic electrons were scattered from thin foils of aluminum, nickel, silver, and gold. The scattered electrons were analyzed by a 90° magnetic spectrometer using a scintillation detector. The absolute cross sections were measured at 30° with an estimated error of 3%, at 60° and 90° with an estimated error of 2%, and at 120° and 150° with an estimated error of 5%. The experimental results were 5 to 10% lower than the values predicted by the Mott theory as evaluated by Doggett and Spencer. When the theory is corrected for the effect of nuclear size and the radiative correction of Schwinger an improved fit results. However, the discrepancy between the corrected Mott theory and the measured cross sections is well outside the experimental error. (auth)

7955

PLURAL SCATTERING OF ELECTRONS AT 1.00 Mev, 1.75 Mev, AND 2.50 Mev. II. V. Spiegel, Jr., W. C. Miller, and B. Waldman (Univ. of Notre Dame, Ind.) Ann. Phys. (N. Y.) 6, 86-9(1959) Jan.

Monoergic electrons were scattered from thin foils of aluminum, nickel, silver and gold. The scattered elec-

trons were analyzed by a magnetic spectrometer. The electron-nuclear cross sections were measured as a function of foil thickness and for scattering angles of 30°, 60°, 90°, 120°, and 150°. The data presented show the onset of plural scattering and may be used as a convenient guide for single scattering. (auth)

7956

ABSOLUTE ELECTRON-ELECTRON DIFFERENTIAL SCATTERING CROSS SECTIONS AT 1.00 Mev, 1.50 Mev, AND 2.00 Mev. III. J. J. Kepes, B. Waldman, and W. C. Miller (Univ. of Notre Dame, Ind.). Ann. Phys. (N. Y.) 6, 90-101(1959) Jan.

Monoergic electrons were scattered from thin Zapon and Nylon foils. The scattered electrons were observed at 30° in the laboratory system (ca 90° c.m.) were analyzed by a magnetic spectrometer. The absolute electron-electron scattering cross sections agree with the theory of Møller to within the experimental error of 4%. The broadening of the momentum distribution of the scattered electrons was in reasonable agreement with the theory of Ford and Mullin. The conservation laws for relativistic particles were experimentally verified to an accuracy of 1%. (auth)

7957

THE EMISSION OF K MESONS IN THE ANNIHILATION OF ANTIPROTONS. Andre Berthelot, Colette Choquet, et al. Compt. rend. 248, 94-7(1959) Jan. 5. (In French)

The characteristics of several K mesons observed in the annihilation of antiprotons and the characteristics of the emission stars are given. The frequency of the events is indicated. (tr-auth)

7958

EFFECT OF THE SCATTERING ANGLE ON THE ENERGY SPECTRA OF ELECTRON BEAMS TRANSMITTED BY A THIN FILM. Charles Fert and Ferdinand Pradal. Compt. rend. 248, 666-9(1959) Feb. 2. (In French)

The effect of the diffusion angle on the value of the characteristic loss of energy suffered by monokinetic electron beams transmitted by a thin film constitutes a criterion which can be used to determine the origin of a given loss (collective oscillations or individual oscillations). The study of the phenomenon was made for films of alumimum, germanium, and manganese. (tr-auth)

7959

THE RECURRENT INTENSITY VARIATIONS OF PRIMARY COSMIC RADIATION IN PERIODS OF MAXIMUM SOLAR ACTIVITY. André Fréon, Jacques Berry, and Jean-Pierre Coste. Compt. rend. 248, 674-7(1959) Feb. 2. (In French)

Some recordings of the variations of intensity of cosmic neutrons, made since October 1956 at the observatory of the Pic du Midi and since July 1957 on the Kerguelen Islands, have shown the existence, since the beginning of the observations and during at least 20 solar rotations, of a cyclic variation with a stable period equal to 27.35 ± 0.1 solar days and a maximum amplitude of 2.2% attained in October 1957. (tr-auth)

7960

DESCRIPTIONS OF ELECTRON ION PLASMA. L. Ya. Kobelev (Gor'kii Urals State Univ.). Fiz. Metal. i Metalloved. 6, 754-6(1958). (In Russian)

The system of particle interactions in a self-consistent-field approximation, considering virtual processes, is described by Schwinger equations for nonrelativistic Green's functions. An equation is obtained for Green's functions for a system consisting of two types of interactions (electrons and ions). (R.V.J.)

7961

THE DIFFUSION COOLING OF NEUTRONS IN FINITE MODERATOR. Mark Nelkin (General Atomic Div. of General Dynamics Corp., San Diego, Calif.). J. Nuclear Energy 8, 48-58(1958).

When a pulse of fast neutrons is thermalized in a finite moderating medium, the asymptotic spectrum at long times is slower than an equilibrium Maxwellian distribution, because of preferential leakage of higher-energy neutrons. This phenomenon of "diffusion cooling" can be observed by examining the variation of the asymptotic neutron lifetime with the size of the moderating medium. In this paper, the phenomenon is investigated within the context of energy-dependent diffusion theory. A variational expression for the decay constant is formulated and evaluated for trial solutions of Maxwellian form for the neutron spectrum. For small deviations from thermal equilibrium, an expression of the form proposed by von Dardel is obtained. The present analysis relates the diffusion-cooling term in this expression to the energy dependence of the transport mean free path, and to the mean square energy transfer between thermal neutrons and moderator. An analysis of the available experimental results for beryllium, graphite, and water is carried out and yields information on the effects of chemical binding on the energy transfer between neutrons and moderator. The results for graphite are consistent with the model of Krumhansl and Brooks for the specific heat. The results for beryllium, however, are not consistent with a Debye model which fits the specific heat, and it is suggested that the diffusion cooling is actually smaller than the available experimental value. The analysis for water is less sound theoretically, but it indicates a considerable hindering of the molecular rotations in the liquid. (auth)

7962

NEUTRON DIFFRACTION AT A HIGH-FLUX REACTOR. G. E. Bacon and R. F. Dyer (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature 183, 35 (1959) Jan. 3.

Structural studies have been made with neutron beams from the research reactor DIDO, where a peak unperturbed flux of about 5×10^{13} neutrons per sq. cm per sec is available. The advantages of using neutron beams from a high-flux reactor for solid-state studies are discussed. (J.H.M.)

7963

EMISSION OF SLOW SECONDARY ELECTRONS. J. M. Anderson (Univ. of Toronto). Nature 183, 241-2(1959) Jan. 24.

Recent measurements indicate that the emission of some secondary electrons depends on interaction between the primary electron and the solid plasma as a whole, the co-operative interaction as opposed to the individual interaction of current theories. In explaining secondary emission, it is suggested that the injection of a primary across the boundary will result in transient motions of the negative charge cloud such that a high local negative charge density forms about the point of entry after a time of the order of the period of the plasma oscillation. The rise of this density forces electrons successively

over the work-function barrier and accelerates them only slightly after ejection. Such secondaries will be instantaneous to a degree beyond experimental requirements, nearly independent of the detailed properties of the primary, of low emission velocity since acceleration after emission is due at most to few electron charges. Emission energies will cover a continuous range since acceleration will depend on the rate of build-up of surface charge after ejection, that is, on the phase of the plasma cycle at ejection. At low primary velocities little energy will be transferred to the plasma since the charge cloud can adjust itself to equilibrium with the moving charge at all stages. Maximum energy will be transferred when the primary electron travels one interaction distance within the plasma in a time of the order of the plasma cycle. Above this velocity energy transfer will fall slowly. (J.H.M.)

7964

THE EFFECT OF A SCALAR MESON INTERACTION BETWEEN MUONS AND BARYONS. I. R. Gatland (Imperial Coll., London). Nuclear Phys. 9, 267-72(1958) Dec. (1).

The effect of a scalar meson interaction (as well as the usual photon interaction) in muon-nucleon scattering is evaluated in second order perturbation theory and is compared with the known properties of the muon. The existence of the new interaction is found to be compatible with the experimental results on the muon range and scattering and the nuclear photo-production of muon pairs if the meson mass is approximately three nucleon masses and the meson has medium strong interactions with baryons and muons. (auth)

7965

GLOBAL AND RESTRICTED SYMMETRY TESTS IN ANTIHYPERON PRODUCTION. B. d'Espagnat and J. Prentki (CERN, Geneva). Nuclear Phys. 9, 326-8 (1958) Dec. (1).

The conditions of "global" and "restricted" symmetry of meson-hyperon interactions are stated and their consequences for hyperon pair creation briefly discussed. (auth)

7966

ANGULAR CORRELATION BETWEEN NEUTRINO AND GAMMA QUANTUM RELEASED BY ELECTRON CAPTURE. K. Nagy (Roland Eolvos Univ.) and J. Zimanyi (Central Research Inst. for Physics, Budapest). Nuclear Phys. 9, 329-33(1958) Dec. (1).

Previous calculations dealing with the angular correlation between the neutrino and gamma quanta resulting from electron capture have been limited to allowed K-capture. These calculations are extended to K-captures forbidden to an arbitrary order and to mixed gamma transitions. (D.E.B.)

7967

ON THE SECOND ORDER WAVE EQUATION OF THE FERMIONS. G. Marx (Roland Eotvos Univ. and Central Research Inst. for Physics, Budapest). Nuclear Phys. 9, 337-46(1958) Dec. (1).

Following the suggestion of Feynman some problems were considered in connection with the description of fermions by a second order wave equation, e.g. the problem of interactions. The possibility of the description of isodoublet fermions by a four-component spinor field is demonstrated. The latter method eliminates some difficulties in connection with forming the commutation rules. The transformation properties of the second order equation are analogous to those of the new nonlinear Heisenberg equation. (auth)

7968

THE STOPPING OF NEUTRONS IN THE ev RANGE IN HYDROGEN CONTAINING SCATTERING SUBSTANCES. Peter Engelmann (Technischen Hochschule, Karlsruhe, Ger.). Nukleonika 1, 125-8(1958) Dec. (In German)

In a hydrogen-containing moderator, energetic neutrons are stopped chiefly by elastic collisions with protons. In the ev range the collision process is influenced by the chemical combination of the protons in the molecules of the scattering medium. From the time which is necessary to slow a neutron from several Mev down to approximately 1 ev, the kind of energy transfer in the ev range can be determined. A measurement of this slowing down time shows that the energy given by neutrons in the sub ev range is used principally for the excitation of the internal molecular motion. In the calculation of the slowing down time, the effect of the chemical bonding is considered so that an effective molecular mass is used instead of the proton mass. From the results of the present investigation the molecular mass M = 2.5 at E = 1.44 ev. (tr-auth)

7969

SOLAR FLARE COSMIC RAYS AND THEIR PROPAGATION. J. A. Simpson (Univ. of Chicago). Nuovo cimento (10) 8, Suppl. No. 2, 133-60(1958).

Of the five large increases of intensity, the event of February 23, 1956, was the most outstanding for quantitative study. It provided direct evidence for the occasional production of particles with energies up to 20 to 30 Bev for protons, evidence for important interplanetary magnetic fields, and evidence on the mode of charged particle propagation from the solar source to the earth. Some of the important experimental results from various locations are reviewed. Recent results concerning the initial stages in the propagation of flare particles are discussed. General features of the increase of cosmic ray intensity are graphically shown. (A.C.)

7970

THE COSMIC RAY FLARE EFFECT. G. Cocconi, K. Greisen, et al. (Cornell Univ., Ithaca, N. Y.). Nuovo cimento (10) 8, Suppl. No. 2, 161-8(1958).

One of the difficulties encountered in trying to explain the sudden increase of cosmic rays observed on the earth following some solar flares is that magnetic fields in the vicinity of the flare in the chromosphere should maintain the cosmic-ray particles in a comparatively small volume and allow them to diffuse only at a very low rate. It is thus necessary to find a mechanism by which cosmic rays can be quickly liberated and distributed through a large volume near the sun so that a magnetic path to the earth is likely. Another major problem concerns the magnetic fields that must exist at distances from the sun as great as the earth's distance in order to account for the arrival of particles in the late stages of the flare effect from a great variety of directions. The magnetic guidance of the particles must be such as to allow them to arrive at the earth quickly in the first place, but to later give the appearance of being diffused. The first problem may be overcome by the assumption of a coöperative propagation mechanism of cosmic rays. There is a limit on the constraining force that the field can exert. It is supposed that when the total cosmic-ray flux exceeds a certain value the containment of the particles becomes

unstable and they can suddenly leak out from the front of the region in which they were contained into all or a great many directions. The instability leads to channels being established so that the cosmic rays can propagate through the fields. Such a process would not only explain how the particles get out from the strong solar fields, but it would also explain the essential threshold nature of the flare effect. It appears that a great many flares, if not all, produce cosmic-ray particles, but only those that produce a sufficient total flux to burst through the containing fields can show up on the earth as a sudden increase in the cosmic rate. The time and space distribution of cosmic rays reaching the earth is discussed. (A.C.)

7971

ON THE UNUSUAL INCREASE AND THE MODULATION OF COSMIC RAYS. K. Kawabata, I. Kondo, K. Murakami, and M. Wada (Tokyo Astronomical Observatory and Scientific Research Inst., Tokyo). Nuovo cimento (10) 8, Suppl. No. 2, 169-75(1958).

Acceleration of the particles up to cosmic-ray energies takes place in the vicinity of the solar flare. The particles are first trapped in a volume of radius 0.2 to 0.4 A, then emitted from this sphere to interplanetary space. These particles arrive at the earth through a very straight line and cause the increase at the impact zone. Another trapping field, which has a dimension of the order of several A, scatters back and stores these particles for several hours. These back-scattered particles cause an increase in the background in the polar regions. The apparent relationship between the event of February 23, 1956, and sun spot activity is discussed. Both experimental facts and calculated results fit the above model fairly well. (A.C.)

7972

IMPACT ZONES FOR SOLAR COSMIC RAY PARTICLES. R. Lust (Univ. of Chicago). Nuovo cimento (10) 8, Suppl. No. 2, 176-9(1958).

Earlier calculations of sun-earth orbits show that cosmic-ray particles coming from the sun arrive at different impact zones on the earth because of their deflection in the geomagnetic field. Orbit calculations were extended both in their number and rigidity range for the flare event of February 23, 1956. Together with prior calculated orbits it was possible to determine primary particle rigidities and the relative counting rates at the top of the atmosphere for different geomagnetic latitudes and longitudes. Relative counting rates at the top of the atmosphere are given as a function of the geomagnetic longitude. For a fixed latitude, particles with highest rigidity arrive in the 0900 hour zone, whereas particles of successively lower rigidity arrive in the 0300 and 2000 hour zones. From these results it must be concluded that the particles which were first to arrive on the earth during the flare onset were those of high magnetic rigidity while those of low rigidity arrived later. (A.C.)

7973

ON THE SEPARATION OF DIRECT AND INDIRECT FRACTIONS OF SOLAR COSMIC RADIATION ON FEBRUARY 23, 1956 AND ON THE DIFFERENCE IN STEEPNESS OF MOMENTUM SPECTRUM OF THESE TWO COMPONENTS. G. Pfotzer (Max-Planck-Inst. fur Physik der Strarosphare, Weissenau). Nuovo cimento (10) 8, Suppl. No. 2, 180-7(1958).

Solar cosmic radiation, which was recorded as five big flare effects, partially entered the earth's magnetic field in the direction from the sun and partially from widely distributed directions. The first kind of radiation, which may be defined as the "direct fraction," was received in the so called "impact zones." The second kind, the "deflected fraction," was received by other stations. It is pointed out that the spectrum of magnetic rigidity of the deflected respective stored radiations should be much steeper than the spectrum of direct radiations. A mathematical analysis confirms this assumption. (A.C.)

7974

THE PRODUCTION OF HIGH ENERGY PARTICLES IN SOLAR FLARES. P. A. Sweet (Univ. of London Observatory). Nuovo cimento (10) 8, Suppl. No. 2, 188-96 (1958).

The topology of the magnetic field above a complex sunspot group is examined. Two properties of the field are established: (a) without Joule dissipation of magnetic energy, magnetohydrostatic equilibrium is impossible when the components of the spot are given arbitrary relative displacements or twists; (b) during the resulting interpenetration of the flux systems, the voltage drop down in the line of force between the neutral points is proportional to the rate of exchange of flux between the two systems. Relative velocities of an order of 10 km/sec between the components would be required in order to explain the production of cosmic-ray particles of the highest energies. Such motion could arise from transverse or torsional hydromagnetic waves traveling upward along the flux tubes below the photosphere. Such a mechanism is consistent with the point-like nature of a flare but does not satisfactorily explain the positions of flares relative to the components of the spot group of the electromagnetic theories of flares; the neutral point theory and the Fermi mechanism offer possible explanations of the production of cosmic rays. The potentialities of the neutral point mechanism are explored. (A.C.)

7975

THE ELECTRO-MAGNETIC STATE IN INTERPLANETARY SPACE DURING THE FLARE OF FEBRUARY 23, 1956. D. Eckhartt (Royal Inst. of Tech., Stockholm). Nuovo cimento (10) 8, Suppl. No. 2, 202-8(1958).

The increase in cosmic-ray intensity in connection with the solar flare of February 23, 1956, was observed at different places around the earth to have started at different times. This means that cosmic-ray particles which have been produced in the vicinity of the sun must have travelled along orbits of different length before reaching the earth. It has been possible to connect the onset time observed at a particular station with certain directions outside the geomagnetic field. The results of the study indicate that those particles which arrived first at the earth did not travel along straight lines from the sun. This proves the existence of deflecting fields between the sun and the earth. Two days after the flare increase, a heavy magnetic storm was registered. There is evidence that magnetic storms are caused by the electric field set up in a field of ionized gas which is emitted from the sun. It is assumed that the magnetic storm of February 25 was caused by such a beam. It is assumed that solar flare cosmic particles can not escape from the vicinity of the sun until they have entered the beam. (A.C.)

7976

ELECTRO-MAGNETIC STATE OF INTERPLANETARY SPACE. H. Alfvén (Royal Inst. of Tech., Stockholm). Nuovo cimento (10) 8, Suppl. No. 2, 209-11(1958).

For the understanding of time variations of cosmic radiation, it is essential to have a model of the magnetic field in interplanetary space. A dipole model was proposed, according to which the interplanetary field is an extension of a solar dipole field. Another model has been proposed according to which there is a field-free cavity around the sun beyond the earth's orbit. Enmert has suggested that a fairly homogeneous galactic magnetic field is of decisive importance even inside the earth's orbit. All of these models encounter difficulties. A tentative model is discussed which is essentially a dipole field, modified by storm-producing beams emitted from the sun. A few hundred cosmic-ray orbits in the field of this model have been calculated. (A.C.)

7977

SOLAR ACTIVITY AND COSMIC RADIATION. D. H. Menzel (Harvard Coll., Cambridge, Mass). Nuovo cimento (10) 8, Suppl. No. 2, 214-17(1958).

Several years ago it was suggested that the sun might be responsible for the softer component of cosmic radiation. It was further noted that an extremely low-frequency electromagnetic radiation which was supposed to be of solar origin might cause cosmic radiation. Some modifications of the original concept have now become necessary. Most workers have taken for granted that the solar cosmic rays originate simultaneously with flare phenomenon. Even in violent flares the energies of individual atoms are small. The production of cosmic rays requires some physical process capable of imparting high energy to a few atoms. A process of this sort can occur only in regions of relatively low density. The comparatively high coronal density seems to preclude the possibility of a process of this sort. As the wave moves into the low-pressure upper corona the above process might occur. (A.C.)

7978

ON THE ORIGIN OF THE SOLAR COMPONENT OF COSMIC RADIATION. K. O. Kiepenheuer (Fraunhofer Inst., Freiburg i. B.). Nuovo cimento (10) 8, Suppl. No. 2, 218-19(1958).

Ascending prominences in the outer corona often reach velocities above 600 km/sec, 3 times the thermal velocity of coronal protons. It is not probable that such prominences move through the corona. It seems much more probable that prominences and the surrounding corona are lifted together by the same force. Coronal films give some evidence in this direction. There can be no doubt that the acceleration force is of a magnetic nature. Under such circumstances, a kind of hollow cavity is formed. Such low-density cavities represent very favorable conditions for the acceleration of cosmic particles. This type of mechanism has the advantage of explaining in a natural way the observed delay between the beginning of a flare and the terrestrial onset of the cosmic-ray burst. (A.C.)

7979

LATITUDE EFFECT OF SOLAR COSMIC RADIATION ON FEBRUARY 23, 1956, WITH RESPECT TO THE PROBLEM OF EFFECTIVE GEOMAGNETIC COÖRDINATE SYSTEM. G. Pfotzer (Max-Planck-Institut für Physik der Stratosphare, Weissenau). Nuovo cimento (10) 8, Suppl. No. 2, 220-7(1958).

It appears that the best approximation to a unique mean trend of points for solar cosmic rays is reached if the conventional geomagnetic system is used as a base and corrections for eccentric dipole location are applied. Though the points for some European and American stations are better aligned in the intermediate westward shifted system, at least two different trends are observed. (A.C.)

7980

DETERMINATION OF LATITUDE EQUIVALENTS FOR SECOND PHASE SOLAR FLARE PARTICLES. P. L. Marsden and J. G. Wilson (Univ. of Leeds, Eng.). Nuovo cimento (10) 8, Suppl. No. 2, 228-32(1958).

The rigidity spectrum over a period of many hours after flare-activity had ceased was such that the response of neutron monitors at sea level exhibited a very strong latitude effect in the middle latitudes. This provides a further approach to the problems, which have already been revealed by other methods, of the relationship of the effective geomagnetic field as it controls particle trajectories near the earth. The response during this second phase of neutron monitors at two groups of stations is examined. (A.C.)

7981

NEW CHANGES IN THE LOW-ENERGY PARTICLE CUT-OFF AND SPECTRUM OF THE PRIMARY COSMIC RADIATION. P. Meyer and J. A. Simpson (Univ. of Chicago). Nuovo cimento (10) 8, Suppl. No. 2, 233-6(1958).

At the Guanajuato conference on cosmic radiation some experiments were reported which showed that the primary cosmic-ray energy spectrum as well as the low-energy cut-off are not permanent features of cosmic radiation but undergo remarkable changes with time. This suggests that the mechanism responsible for the low-energy cut-off is operating within or in the vicinity of the solar system. It was suggested at that time that the observed phenomena may be solar controlled and related to the activity cycle of the sun. Information on changes in spectrum and cut-off was obtained by measuring the nucleonic component intensity as a function of geometric latitude at high altitude. The results of the investigation are graphically shown. (A.C.)

7982

DIRECTIONAL PROPERTIES OF COSMIC RAY TELESCOPES. E. Å. Brunberg (Royal Inst. of Tech., Stockholm). Nuovo cimento (10) 8, Suppl. No. 2, 237-43(1958).

In the study of cosmic-ray intensity and its time variations, different kinds of recording apparatuses have been used, including ionization chambers and Geiger-Mueller telescopes. In this way different time variations are observed. Knowledge of that part of the variation which is induced by the atmosphere seems now to be fairly well established, but the mechanism of the extra-terrestrial variations is subject to several theories. The optics of cosmic-ray telescopes is discussed. The problem is as follows: given a cosmic-ray source with known spectrum located in a given direction far away from the earth, what is the counting rate of a telescope on the earth pointing in a given direction? As in ordinary optics the case of a point source (in this case a cosmic-ray point source) infinitely far away from the earth is treated. The image (intensity count) given by the telescope is recorded during one day. Using this result it is then possible to deduce the image of any cosmic-ray source. (A.C.)

7983

SHIPBOARD NEUTRON MONITOR DETERMINATION OF COSMIC-RAY EQUATOR. M. A. Pomerantz (Franklin Inst., Swarthmore, Penna.); A. E. Sandstrŏm (Uppsala Univ.); and D. C. Rose (National Research Council of Canada, Ottawa). Nuovo cimento (10) 8, Suppl. No. 2, 257-62(1958).

It is known that the dipole approximation to the earth's magnetic field derived from surface measurements does not provide adequate geometric coŏrdinates for describing the observed spatial distribution of cosmic-ray intensities. To facilitate a detailed analysis of this problem a global map of the contours of equal ray intensity is being made using neutron monitors on shipboard. Since the program is still in progress, no attempt is made to present all the results obtained thus for or to discuss the implications in detail. (A.C.)

7984

COSMIC RAY SOFT COMPONENT MEASUREMENTS DURING A FLIGHT FROM SCANDINAVIA ACROSS THE NORTH POLE AND AROUND ASIA AND EUROPE. A. E. Sandstrŏm (Uppsala Univ.). Nuovo cimento (10) 8, Suppl. No. 2, 263-76(1958).

During the geophysical year cosmic-ray measurements, including those with neutron monitors, were to be made at a number of stations in the northern polar region. Plans called for the collection of data on the soft component variations across this region along two meridians as opposite to each other as possible. With the aid of the Scandinavian Airlines System this project was undertaken, the neutron monitor being returned along the usual commercial flight routes over the southern parts of Asia and Europe. The survey includes several regions inaccessible by shipborne instruments. Some of the results of data taken so far are graphically shown. (A.C.)

7985

FURTHER EXPERIMENTS CONCERNING THE GEOMAGNETIC FIELD EFFECTIVE FOR COSMIC RAYS. L. Katz (Geophysics Research Directorate, Cambridge, Mass.) and P. Meyer and J. A. Simpson (Univ. of Chicago). Nuovo cimento (10) 8, Suppl. No. 2, 277-82 (1958).

Since cosmic-ray particles begin to interact with the terrestrial magnetic field at considerable distances from the earth, these particles provide important information concerning the description of the magnetic field extending beyond the surface of the earth. The relationship between magnetic fields and cosmic-ray intensity measurements in the equatorial zone are discussed. The effective geomagnetic field equator for cosmic-ray particles is defined as the line of minimum cosmic-ray intensity around the earth. Experiments were begun in 1954 which were concerned with certain basic questions concerning the terrestrial field. Additional experiments have recently been undertaken. The analysis of the data is not yet complete, but some preliminary results are given. (A.C.)

7986

LATITUDE EFFECT OF COSMIC RAY NUCLEON AND MESON COMPONENTS AT SEA LEVEL. M. Kodama (Scientific Research Inst., Tokyo). Nuovo cimento (10) 8, Suppl. No. 2, 283-4(1958).

During the period from November 1956 to April 1957, measurements of cosmic ray nucleon and meson components were made on an icebreaker voyage to and from the Antarctic. Absolute intensity of the neutrons observed at the high latitude was about 8000 counts per hour. The meson component was observed with a Neher type ionization chamber. Day to day intensity variations are graphically shown. The analysis of the data is not yet complete. (A.C.)

7987

THE 27-DAY VARIATION IN COSMIC RAY INTENSITY. D. Venkatesan (Royal Inst. of Tech., Stockholm). Nuovo cimento (10) 8, Suppl. No. 2, 285-97(1958).

The study of electromagnetic phenomena like magnetic storms, aurorae, and certain types of cosmic-ray effects like the 27-day variation in intensity is of importance for the proper understanding of the interplanetary electromagnetic state. Since solar activity appears to influence the electromagnetic conditions in interplanetary space, changes in solar activity during its eleven-year cycle would be revealed in the above effects. The relation between the transient behavior of the geomagnetic field and cosmic-ray intensity appears to be definitely established. Graphical data indicate that the amplitude of the 27-day variation in cosmic-ray intensity is more closely connected with geomagnetic activity than with solar activity. (A.C.)

7988

CHANGES OF SOLAR ANISOTROPY AND OF THE INTENSITY OF COSMIC RADIATION. V. Sarabhai and P. D. Bhavsar (Physical Research Lab., Ahmedabad, India). Nuovo cimento (10) 8, Suppl. No. 2, 299-312 (1958).

Solar and terrestrial relationships of the changes of anisotropy have been studied, and theories have been advanced to explain the creation of the anisotropy by a modulation of cosmic-ray intensity incident at particular directions. The results of the investigation presented are of a preliminary character and indicate certain tentative conclusions which can be drawn from the analysis of data from narrow-angle telescopes operated over a period of eleven months in 1956. One of the most important conclusions is that there is a definite correlation between day to day changes of anisotropy and the daily mean intensity. (A.C.)

7989

SOLAR DAILY COSMIC RAY VARIATIONS OBSERVED WITH MESON TELESCOPES AT HIGH SOUTHERN LATITUDES. N. R. Parsons and A. G. Fenton (Univ. of Tasmania, Hobart). Nuovo cimento (10) 8, Suppl. No. 2, 313-17(1958).

Solar daily variations in meson intensity were recorded at Hobart, Tasmania (λ = 52°S), and at Mawson, Antarctica (λ = 73°S). A comparison was made of the phase of the daily and long-term variations recorded by vertical telescopes. A comparison was also made of the daily variations recorded simultaneously at Mawson by telescopes directed vertically, 45°N, 45°E, 45°S, and 45°W of the zenith, respectively. The results of the study are not consistent with an explanation of the daily variation in terms of an external anisotropy and its interaction with a "normal" dipole field. It is suggested that the daily variations probably arise from some modulation mechanism operating within the region occupied by the earth's field. (A.C.)

7990

VARIATIONS OF NUCLEAR AND MESONIC COMPONENT. A. Ehmert (Max Planck-Inst. für Physik der

Stratosphäre, Weissenau). Nuovo cimento (10) 8, Suppl. No. 2, 318-25(1958).

Measurements from 6 telescopes and a neutron counter, free from μ-meson decay influence, were correlated in an effort to establish an expected meson variation for constant atmospheric conditions. Both measured and calculated values are given and discussed. (D.E.B.)

7991

OBSERVATION OF COSMIC RAY DECREASES AT THE POLE. S. F. Singer (Univ. of Maryland, College Park). Nuovo cimento (10) 8, Suppl. No. 2, 326-33(1958).

Careful measurements show an increase in cosmic-ray intensity with latitude; however, the present investigation was concerned with cosmic-ray decreases in the region of the pole. Measurements were made at four stations during May and June 1951 using a vertical Geiger counter telescope. There is a clear recurrence of cosmic storms with a period of about 27 days, the period of rotation of the sun. The cause of the 27-day variation is not settled. No attempt is made to explain Forbush decreases. It appears, however, that the cause must be a decrease in the number of primary cosmic rays or a deceleration of the particles before entering the earth's atmosphere or both screening and deceleration. (A.C.)

7992

COSMIC RAY TIME VARIATIONS PRODUCED BY DECELERATION IN INTERPLANETARY SPACE. S. F. Singer (Univ. of Maryland, College Park). Nuovo cimento (10) 8, Suppl. No. 2, 334-41(1958).

Several theories of the Forbush decrease are offered which appear to be satisfactory. Various models are proposed. The model proposed in this investigation to explain the storm decrease makes use of a magnetic, turbulent cloud. It is assumed that the cloud is expanding and that cosmic rays are reflected back and forth in a region where the turbulent energy is decreasing. It appears that an "inverse Fermi' mechanism is in operation in which particles are decelerated. Forbush has recently published the records obtained with lead-shielded ion chambers at various stations throughout the world. Many irregular fluctuations are observed simultaneously at all stations. Overriding all of these irregular time variations was a pronounced trend associated with the solar cycle. (A.C.)

7993

ON THE LOW ENERGY CUT-OFF OF THE COSMIC RADIATION. S. F. Singer (Univ. of Maryland, College Park). Nuovo cimento (10) 8, Suppl. No. 2, 342-8(1958).

The existence of latitude cut-off flux due to the absence of low-energy primaries has been established near 58° in rocket and balloon experiments carried out during 1950 to 1951. More recent experiments (1954) were carried out in which no cut-off was found. Some questions are raised in the interpretation of the low-energy cut-off in the primary radiation and of its apparent shift with time. The minimum of the solar cycle was reached in 1954. Apparently the presence of the knee, or at least its position, is correlated with the sun spot number. (A.C.)

7994

STÖRMER ORBITS OF LOW ENERGY. A. Schlüter (Max Planck Institute fur Physik, Göttingen, Ger.). Nuovo cimento (10) 8, Suppl. No. 2, 349-57(1958).

Not all latitudes remain accessible to particles coming from infinity, but for decreasing A (Störmer unit of length), starting at A = 0.5, a belt of increasing width around the equator forms a forbidden region. A line of force in this region, having particles of fixed rigidity spiralling around it, is considered. (D.E.B.)

7995

TRUE PRIMARY ENERGY SPECTRUM VARIATIONS AND SOLAR ACTIVITY. L. I. Dorman and E. L. Feinberg (Scientific Inst. for Terrestrial Magnetism, Ionosphere and Propagation of Radio Waves, Moscow and P. N. Lebedev Physical Inst. USSR Academy of Sciences, Moscow). Nuovo cimento (10) 8, Suppl. No. 2, 358-78(1958).

In order to obtain true primary variations, meteorological variations must be eliminated. A method of eliminating atmospheric effects has been developed, tested, and applied. The method was applied to the deduction of true variations, essential in connection with solar activity, namely, of long-term seasonal changes of diurnal variations and for the determination of the direction of the source of diurnal variations. The results differ in many points from those of other investigators. This method of elimination is now limited only by the accuracy of temperature data. It is used systematically at all Soviet stations for permanent recording of cosmic rays. (A.C.)

7996

SOLAR CORPUSCULAR STREAMS AND COSMIC RAY VARIATIONS. L. I. Dorman and E. L. Feinberg (Scientific Inst. for Terrestrial Magnetism, Ionosphere and Propagation of Radio Waves, Moscow and P. N. Lebedev Physical Inst. of the USSR Academy of Sciences, Moscow). Nuovo cimento (10) 8, Suppl. No. 2, 379-90(1958).

The idea that corpuscular streams of highly ionized neutral matter, ejected by the sun, may lead to variations of cosmic rays of extrasolar origin is due to Alfvén. The idea was further developed by Brunberg and by Trumpy and applied successfully to a particular case of crossed telescope observations by Elliott and Dolebear. This idea in its original form has lost popularity. There is evidence that the passage of cosmic rays through an average stream actually gives variations on earth with exactly the kind of spectrum necessary to explain diurnal variations. (A.C.)

7997

THE GENERATION AND PROPAGATION OF SOLAR COSMIC RAYS. L. I. Dorman (Scientific Inst. for Terrestrial Magnetism, Ionosphere and Propagation of Radio Waves, Moscow). Nuovo cimento (10) 8, Suppl. No. 2, 391-402(1958).

The mechanisms of generation and propagation of solar cosmic particles in the solar system during the outburst of February 23, 1956, are discussed. In the initial period of the outburst, there was a well impressed impact zone which showed the anisotropy of the additional cosmic flow. Calculations showed this flow came from the sun. The particles arrived in the impact zone and in the background zone almost simultaneously, but there was a tendency towards earlier arrival by as much as two or three minutes at lower latitudes. On the rest of the earth's surface the particles arrived as much as ten minutes late. The existence and location of impact zones at the initial stage of the outburst were in agreement with expectations due to the influence of the earth's magnetic field on the trajectories of solar particles. This proved that a regular, uniform magnetic field does not exist between the earth and the sun. A model was

proposed to explain the variations of intensity during the outburst. From energy relations it was shown that the generation of solar cosmic rays took place in an enormous chromospheric outburst. (A.C.)

7998

THE ORIGIN OF COSMIC RAYS: SOME ASTROPHYSICAL PROBLEMS. G. R. Burbidge (Carnegie Inst. of Washington and California Inst. of Tech., Pasadena). Nuovo cimento (10) 8, Suppl. No. 2, 403-20(1958).

The origin and acceleration of cosmic particles are discussed. Particles can either be ejected from stellar atmospheres, in stellar explosions, or from gaseous nebulae. Stellar explosions are characterized by sudden large increases in luminosity, and in some cases by measurements on the Doppler shifts of spectral features which show that material is moving rapidly out from the seat of the explosion. Supernovae, novae, and flares all appear to be different types of stellar explosions. Supernovae have long been proposed as primary sources of cosmic rays. A theory under which primary particles could be produced is proposed. According to this theory, supernovae are the source of neutron-rich isotopes of the heavy elements and of uranium and thorium and the trans-uranium elements. They are synthesized when a base material is subjected very rapidly to an extremely large neutron flux. The acceleration mechanism inside galaxies and extragalactic acceleration mechanisms are discussed. (A.C.)

7999

SOME PROBLEMS OF RADIOASTRONOMICAL THEORY OF THE ORIGIN OF COSMIC RAYS. I. S. Šklovskij (Sternberg State Astronomical Inst., Moscow). Nuovo cimento (10) 8, Suppl. No. 2, 421-9(1958).

In 1950 Alfvén and Herlfson as well as Kiepenhens showed that nonthermal cosmic radiation may be explained by relativistic electrons moving in interstellar magnetic fields. Since the nonthermal radioemission of the galaxy is caused by relativistic electrons that move in interstellar magnetic fields, it becomes possible to observe the electron component of the primary cosmic rays in the universe. From the analysis of the nature of nonthermal radioemission and of the physical conditions of discrete sources it was concluded that only relativistic electrons moving in magnetic fields can be responsible for their radiation. From the observed flux of radioemission of the Crab Nebula, the quantity of relativistic electrons and their energy were evaluated. These calculations showed that an explosion of a supernova results in the formation of a large number of relativistic particles. It has been shown that taking into account the frequency of out bursts of supernovae in our galaxy and the "duration of life" of cosmic rays in interstellar media, the quantity of relativistic particles actually formed during these out bursts was quite enough to provide the observed concentration of primary cosmic rays. Thus it was shown that supernovae explosions may be the injectors of primary cosmic rays in our stellar system. (A.C.)

8000

ON THE ORIGIN OF COSMIC RAYS. V. L. Ginzburg (P. N. Lebedev Inst. of Physics, USSR Academy of Sciences, Moscow). Nuovo cimento (10) 8, Suppl. No. 2, 430-9(1958).

This paper was previously abstracted from the original language and appears in NSA Vol. 13, as abstract No. 322.

8001

VARIATION OF THE INTENSITY OF COSMIC RADIATION DURING EARTH'S GEOLOGICAL HISTORY AND THEIR POSSIBLE INFLUENCE OF LIFE'S EVOLUTION. V. I. Krassovskij and I. S. Sklouskij (Sternberg States Astronomical Inst., Moscow). Nuovo cimento (10) 8, No. 2, 440-3(1958).

It has been shown that both the Crab Nebula's radio and optical emissions are caused by relativistic electrons that move in magnetic fields. As a consequence this nebula contains a great number of relativistic particles, i.e., primary cosmic rays. Recently it was found that nebulae in Cygnus, a remnant of a supernova explosion which took place several thousand years ago, are also sources of radioemissions. When, owing to the Crab Nebula expansion, its radius will be ~5 parsecs, the concentration of relativistic particles will still be 30 times larger than the concentration of primary cosmic rays in the neighborhood of the earth. The sun with its planetary system at times gets into regions of cosmic radiation tens or even hundreds of times higher than at present. This took place when the supernova exploded in the immediate proximity of the sun. During the last 1000 years, at least 5 explosions of supernovae took place in our galaxy. Their distances did not exceed 2000 to 2500 parsecs. Once in 200 million years a supernova explodes at a distance less than 8 parsecs. The biological and genetic consequences of such cosmic-ray increases are discussed. (A.C.)

8002

AN EXAMINATION OF THE FERMI MECHANISM. L. Davis, Jr. (California Inst. of Tech., Pasadena). Nuovo cimento (10) 8, Suppl. No. 2, 444-56(1958).

The Fermi mechanism accounts for the acceleration of cosmic rays by random motions of magnetic fields embedded in gas clouds. Some of the proposed modifications are examined. Serious difficulties were found, but it seems likely that when the origin of cosmic rays is finally understood, some variant of the Fermi mechanism will be involved. Regions where the mechanism is operative are listed. Special consideration is given to its operation in the spiral arm of our galaxy. Injection, storage, removal processes, isotropy, and acceleration mechanisms are discussed. (A.C.)

8003

GALACTIC ORIGIN OF COSMIC RADIATIONS. C. Y. Fan (Yerkes Observatory, Williams Bay, Wis. and Univ. of Chicago). Nuovo cimento (10) 8, Suppl. No. 2, 457-65(1958).

If cosmic radiations are not the energetic particles "left over" from the creation of the universe, and if they are not produced by a violent process such as the explosion of a supernova, then the problem of the origin can be subdivided into three parts: (a) the acceleration of charged particles from thermal energy to $\sim 10^{10}$ ev; (b) the subsequent acceleration from 10^{10} ev to 10^{17} ev, at which the Larmor radii of the particles in the galactic magnetic field become comparable to the size of the galaxy; (c) and the acceleration of cosmic particles of higher energies. The first acceleration can take place in the neighborhood of stars, though the actual mechanism is unknown. One of the outstanding evidences of this is the solar flare of February 23, 1956, where cosmic-ray intensity was increased by a factor of one hundred fifty and particles of energy up to 3×10^{10} ev were detected. The acceleration of particles of energy

higher than 10^{17} ev has to take place in intergalactic space or in other galaxies, since these particles can no longer be confined in our own system. This investigation is concerned with the acceleration of cosmic radiation of energies from 10^{10} to 10^{17} ev. (A.C.)

8004

COSMIC RAYS IN INTERGALACTIC SPACE. F. J. M. Farley (Centre Européen de Recherches Nucléaries, Geneva). Nuovo cimento (10) 8, Suppl. No. 2, 466-71 (1958).

Observations of extensive air showers indicate the existence of primary cosmic rays of energy approaching 10^{19} ev. It is difficult to see how particles of this energy can be confined to the galaxy long enough for such acceleration. The alternate hypothesis that cosmic rays escape rather easily from the galaxy and diffuse from galaxy to galaxy throughout the universe is considered. The existence of cosmic rays in other galaxies with fluxes comparable to our own is inferred from observations of galactic radio emission. If the source strength is sufficient to accelerate particles in galaxies with an equivalent characteristic time of an order to 100,000 years, then it is reasonable to postulate cosmic rays throughout all space. (A.C.)

8005

THE EXTERIOR BALLISTICS OF THE COSMIC RADIATION. G. Cocconi (Cornell Univ. Ithaca, N. Y.). Nuovo cimento (10) 8, Suppl. No. 2, 472-7(1958).

The problem of the origin of cosmic rays has been affected in recent years by the necessity of admitting that the most energetic part of cosmic rays on the earth come from outside the galaxy and also by the fact that inside and outside the galaxy there exist peculiar regions where particles are accelerated to relativistic energies. Estimates of the energy output of these sources show that supernovae and novae in our galaxy flare with sufficient frequency to supply all the energy we observe in cosmic rays. The same is probably true for the supply of cosmic rays in the inter-galactic spaces from objects like jet nebulae and colliding galaxies. These observations make it necessary to change the principal hypothesis on which most of the models of the origin of cosmic rays is based. It appears that for the purpose of studying interior ballistics more information can be obtained from the analysis of the phenomena occurring on the sun, where particles up to 10^{12} ev are occasionally created, than from the analysis of the incoherent particles that form the bulk of cosmic radiation. (A.C.)

8006

EXTRAGALACTIC COSMIC RADIATION. K. Sitte (Israel Inst. of Tech., Haifa). Nuovo cimento (10) 8, Suppl. No. 2, 478-81(1958).

Some ideas on extragalactic cosmic radiation are presented as speculations and suppositions. There are two lines of thought which lead to an investigation of the problems of extragalactic cosmic radiation. The cosmological effects of diffusion into intergalactic space of radiation produced or stored in the galaxies should be studied; on the other hand, the possibilities and consequences of extragalactic production could be re-examined. The flux entering intergalactic space from all galaxies might be compared with the rate of continuous production of matter in a steady-state universe. If the assumption is made that a fraction of the order of 10^{-3} of the galactic flux is allowed to pass through the boundaries, the rate of increase of energy density in intergalactic space would be many orders of magnitude less than that demanded by the steady-state theories. (A.C.)

8007

A POINT SOURCE OF COSMIC RAYS AND ITS TIME VARIATION. Y. Sekido, S. Yoshida, et al. (Nagoya Univ., Japan). Nuovo cimento (10) 8, Suppl. No. 2, 482-5(1958)

A point source of cosmic rays was reported in 1955 at declination 0° and right ascension 5 hr 30 min. Two G.-M. telescopes were used. Over a period of several years the point source has been observed four times with two telescopes at two different azimuths. The existence of a point source of cosmic rays has been confirmed and its variations observed. (A.C.)

8008

CONTINUOUS CREATION OF COSMIC RAYS. J. Heidmann (Laboratoire de Physique, École Polytechnique, Paris). Nuovo cimento (10) 8, Suppl. No. 2, 486-90 (1958).

Recent experiments on large air showers indicate that cosmic rays exist with such high energy that they cannot be confined in the galaxy and they cannot be accelerated in the galaxy by hydromagnetic processes. Furthermore, the time scale for acceleration in extragalactic space cannot reasonably be made smaller than the expansion time constant of the universe. A different approach was made to the problem of the origin of high-energy cosmic rays inspired by Bondi and Gold's theory of continuous creation. In a steady-state infinite universe there would be continuous creation, throughout all space, of nucleons of energy larger than the highest observed. These super-cosmic rays travel in a straight line through the universe, crossing from time to time a galaxy. In a galaxy they will have some probability of suffering a nuclear collision with interstellar hydrogen. In these collisions they will create a number of lower energy nucleons, which, when charged, will have some probability of being trapped in the galactic magnetic fields and degrade more and more into lower energy nucleons or secondary super-cosmic rays. Some of the consequences of such a scheme are discussed. (A.C.)

8009

GENERAL OBSERVATIONS ON THE ORIGIN PROBLEM. H. Alfvén (Royal Inst. of Tech., Stockholm). Nuovo cimento (10) 8, Suppl. No. 2, 491(1958).

Evidence is presented to prove that it is highly improbable that the sun is the primary source of cosmic rays. (A.C.)

8010

THE PRIMARY ALPHA PARTICLE SPECTRUM OVER NORTH AMERICA AND GEOMAGNETIC CUT-OFF ENERGIES. P. Fowler, P. S. Freier, and E. P. Ney (Univ. of Minnesota, Minneapolis). Nuovo cimento (10) 8, Suppl. No. 2, 492-9(1958).

A series of flights in North America has shown that cosmic-ray cut-off energies can not be computed with conventional geomagnetic coördinates. The measured cut-off indicates that the effective cosmic-ray latitudes in the United States are 4° higher than would be obtained from conventional geomagnetic coördinates. The measurements reported, taken together with the English measurements, appear to be consistent with the suggestion of Rothwell that cosmic-ray coördinates more nearly resemble the magnetic dip coordinates of the earth than the geomagnetic coordinates. Over the period

of the sun spot cycle, which these measurements cover, there appears to be no evidence within the statistics of the experiments of a correlation between the α-particle fluxes and solar activity. (A.C.)

8011

STUDY OF PRIMARY COSMIC RAY ALPHA AND PROTON ENERGY SPECTRA, GEOMAGNETIC CUT-OFF ENERGIES AND TEMPORAL VARIATIONS. F. B. McDonald (State Univ. of Iowa, Iowa City). Nuovo cimento (10) 8, Suppl. No. 2, 500-7(1958).

A new detector is described employing both a Cherenkov counter and a scintillation counter for measuring the cosmic-ray charge and energy spectrum. Alpha and proton energy spectra, α cut-off energies, and temporal variation obtained during a series of Skyhook balloon flights are discussed. Five of the Skyhook flights reached an altitude greater than 114,000 feet. The α integral and differential energy spectrum data are tabulated and plotted. The α differential spectrum has a maximum in the vicinity of 325 Mev/nucleon and decreases at lower energies. The calculated cut-off energy for alpha particles at 55° was found to be 330 Mev/nucleon, in agreement with the data of Fowler et al. (A.C.)

8012

FLUX OF PRIMARY HELIUM NEAR THE GEOMAGNETIC EQUATOR. M. M. Shapiro, B. Stiller, and F. W. O'Dell (U. S. Naval Research Lab., Washington). Nuovo cimento (10) 8, Suppl. No. 2, 509-12(1958).

The abundance of elements in primary cosmic radiation and the nature of their energy spectra is of great cosmological interest. The intensity of the helium component is fairly well known from investigations north of 40° geomagnetic latitude. Until recently the flux of primary helium near the geomagnetic equator was not well known. Extensive work on primary helium was done by means of flights in Minnesota and in the vicinity of White Sands, New Mexico. The main flux for the helium component at White Sands (41° North latitude) is 90 ± 3 peters. There has been a scarcity of data at very low latitudes. In 1950 Singer found an upper limit of (14 ± 20) peters. The flux of helium was measured in a stack of stripped emulsion exposed in the stratosphere near the geomagnetic equator off the Galapagor Islands in 1953. The emulsion stack remained above 90,000 feet for six hours. Of nearly 1200 tracks finally chosen for study, 328 had to be attributed to relativistic helium nuclei on the basis of their ionization vs. range. Because of the uncertainty in the absolute primary fluxes of hydrogen at various latitudes, it does not appear feasible at present to give a definitive figure for the relative abundance of helium and hydrogen in cosmic radiation. (A.C.)

8013

THE LIGHT AND MEDIUM NUCLEI IN THE COSMIC RADIATION. C. J. Waddington (H. H. Wills Physical Lab., Bristol, Eng.). Nuovo cimento (10) 8, Suppl. No. 2, 513-17(1958).

The relative abundances of L and M nuclei were determined as part of an investigation into the complete charge spectrum of cosmic nuclei. From a nuclear emulsion detector, exposed at a height of 106,000 feet over northern Italy, the cut-off energy for multiple charged particles was determined to be (1.55 ± 0.06) Bev per nucleon. The ionization, and thus the charges, of the L and M nuclei were measured by statistically independent methods, δ-ray counting and blob-gap counting on the cores of the tracks. The results of the investigation are graphically shown. (A.C.)

8014

THE FLUX OF MEDIUM AND HEAVY NUCLEI IN THE COSMIC RADIATION NEAR THE EQUATOR. C. J. Waddington (H. H. Wills Physical Lab., Bristol, Eng.). Nuovo cimento (10) 8, Suppl. No. 2, 518-19(1958).

A determination was made of the fluxes of medium and heavy nuclei in primary cosmic radiation, using a stack of nuclear emulsions over Guam (λ = 40°N), at an altitude of 101,000 feet for 7 hrs. The emulsions were scanned for the tracks of heavy nuclei, and a determination of the charge was made by δ-counting. A clear resolution was achieved between particles of the various charge groups. (A.C.)

8015

THE HEAVY NUCLEI IN THE COSMIC RADIATION. R. R. Hillier and V. Y. Rajopadhye (H. H. Wills Physical Lab., Bristol, Eng.). Nuovo cimento (10) 8, Suppl. No. 2, 520-2(1958).

The charges of relativistic nuclei in nuclear emulsions were estimated by measuring delta-ray densities along their tracks by means of a photometric densitometer. The basic principle of the method is to measure the ratio of the obscuration produced by the delta rays to that produced by the core of the track. The results of the measurements on 160 tracks are graphically shown. A statistical analysis of the readings showed that the standard deviation was $1\frac{1}{2}$ charge throughout the spectrum. (A.C.)

8016

THE CHARGE SPECTRUM OF LIGHT ELEMENTS AT 41° N GEOMAGNETIC LATITUDE. B. J. O'Brien, A. J. Herz, and J. H. Noon (Univ. of Sydney). Nuovo cimento (10) 8, Suppl. No. 2, 524-31(1958).

A stack consisting of 15 sheets of 600-μ Ilford G-5 emulsion without support, 9-in. × 10-in., was flown for six hours at an altitude of 110,000 feet. The flight took place at geomagnetic latitude 41°N, on February 6, 1957. A total of 144 tracks of relativistic nuclei in the range $4 < Z < 10$ was found. In addition to the 144 tracks of nuclei with $Z < 10$, the tracks of 30 nuclei with $Z > 10$ were found. At the altitude of observation the abundance ratio of the heavy to the medium nuclei was 0.35 while the ratio of light to medium nuclei was of the order of 0.7. (A.C.)

8017

THE CHARGE COMPOSITION AND ENERGY SPECTRA OF PRIMARY COSMIC RAYS AND THE ENERGY BALANCE PROBLEM. W. R. Webber (Imperial Coll., London). Nuovo cimento (10) 8, Suppl. No. 2, 532-45 (1958).

The results on the intensities, energy, and charge spectra of primary cosmic radiation obtained in a series of balloon flights at geomagnetic latitudes 41.5° and 4° using a Cherenkov detector are summarized. The energy spectra of the various charge components of the primary radiation were used in an attempt to explain the discrepancy between the amount of energy carried by primary cosmic radiation and that dissipated in the atmosphere and underground by primaries and various secondary components. It appears that using the derived energy spectra, reasonable agreement can be obtained between the energy brought in by the primary radiation and that dissipated by the primaries plus their secondaries for $\lambda < 40°$. (A.C.)

8018

ENERGY SPECTRA OF PRIMARY COSMIC RAYS AND THE INTERPRETATION OF THEIR ORIGIN. S. F. Singer (Univ. of Maryland, College Park). Nuovo cimento (10) 8, Suppl. No. 2, 546-8(1958).

A comprehensive analysis was made of experimental data on primary cosmic radiation. Experimental evidence indicates that the proton and α components of primary radiation have different energy spectra. This statement applies only to the latitude sensitive, relativistic region; at higher energies the proton spectrum steepens. If such a situation exists, the premise must be accepted that cosmic rays are accelerated in stellar envelopes, especially those of active stars and the shells of supernovae. (A.C.)

8019

ON THE ORIGIN OF THE CHARGE SPECTRUM OF THE PRIMARY COSMIC RADIATION. S. F. Singer (Univ. of Maryland, College Park). Nuovo cimento (10) 8, Suppl. No. 2, 549-55(1958).

The question is raised as to whether the charge spectrum of primary cosmic radiation (i.e., at the top of the atmosphere) is the same as that of the original cosmic radiation, or have modifications taken place in travel between the origin and the earth. The most widely held opinion is that no modifications, or at any rate very minor ones, have taken place and that the primary charge spectrum represents essentially the original charge spectrum and also resembles the general abundance of elements in the universe. A consequence of this hypothesis is that cosmic radiation during its existence can not have made many collisions in the galaxy. This means that the lifetime of cosmic rays in the galaxy must be very short (less than 4 million years). Then the cosmic rays must escape rapidly from the galaxy, that is, the trapping field can not be a very efficient one; as a further consequence, the rate of acceleration of cosmic rays must be very rapid to replenish the cosmic rays which escape. Prompted by the apparent success of the explanation of synchrotron radiation from Crab Nebula, Hayakawa was suggested a supernova origin for cosmic rays and pointed to the fact that the injected nuclei would be mostly heavy, since a supernova is thought to contain a high abundance of heavy nuclei. (A.C.)

8020

GENERAL OBSERVATIONS ON THE COMPOSITION OF THE PRIMARY RADIATION. B. Peters (Tata Inst. for Fundamental Research, Bombay). Nuovo cimento (10) 8, Suppl. No. 2, 556-9(1958).

Observations indicate that all primary components have the same energy spectrum and that it can be expressed as a power law with exponent 1.5 ± 0.05. The proton spectrum below 10 Bev is perhaps somewhat flatter. Cosmic-ray particles produced in the galaxy escape after traversing, on the average, not more than 4.5 g/cm^2 of interstellar hydrogen. (A.C.)

8021

INTRODUCTORY REMARKS ABOUT AIR SHOWERS. G. Cocconi (Cornell Univ., Ithaca, N. Y.). Nuovo cimento (10) 8, Suppl. No. 2, 560-6(1958).

Air showers are discussed from the standpoints of (1) lateral distributions, (2) characteristics of nucleon-nucleon interactions, and (3) primary energy spectrum. Measurements on lateral distribution of ionizing particles around the core of the shower have been carried out with G-M counters. Recently the MIT group made similar experiments near sea level with scintillators. There was a remarkable agreement between experimental and calculated distribution curves. It appears that in the lower atmosphere the behavior of air showers is dictated by the nucleonic component still present in the core of the showers and not by the electromagnetic cascade started in the upper atmosphere. (A.C.)

8022

ČERENKOV RADIATION IN THE ATMOSPHERE AND ITS APPLICATION TO THE STUDY OF EXTENSIVE AIR SHOWERS. J. V. Jelley (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuovo cimento (10) 8, Suppl. No. 2, 578-84(1958).

After Blackett's prediction that a fraction $\sim 10^{-4}$ of the total intensity of the light of the night sky should be produced by Cherenkov radiation from the passage of cosmic-ray particles through the atmosphere, Galbraith and Jelley discovered that intense pulses of light associated with air showers of primary energy $>10^{14}$ ev could be detected with very simple apparatus. This discovery was followed by a number of exploratory experiments which revealed that the light pulses were due to Cherenkov radiation. Further confirmation came from laboratory experiments on single particles in air in the absence of background light. This investigation was concerned with some of the general features of the technique and its practical applications to the study of air showers themselves. (A.C.)

8023

THE HIGH-ENERGY NUCLEAR ACTIVE COMPONENT OF EXTENSIVE AIR SHOWERS. V. A. Dmitriev, G. B. Hristiansen, and G. V. Kulikov (Moscow State Univ., Moscow). Nuovo cimento (10) 8, Suppl. No. 2, 587-97 (1958).

An attempt was made to study nuclear cascades statistically in extensive air showers at sea level. Pulse ionization chambers placed under a combined absorber were used to register nuclear active particles and to determine their energy. The measured spectrum of extensive air showers shows a maximum at $N = 2.5 \times 10^4$ The spatial distribution of axes proved practically uniform in the circle R = 2.5 m. (A.C.)

8024

ON THE LATERAL DISTRIBUTION OF ELECTRONS AND μ-MESONS IN EXTENSIVE AIR SHOWERS. G. B. Hristiansen (Moscow State Univ., Moscow). Nuovo cimento (10) 8, Suppl. No. 2, 598-605(1958).

A graphical comparison of experimental lateral distribution of electrons in extensive air showers with theoretical distribution shows a good fit. The coincidence of the experimental curve with the theoretical curve with one definite value of S in such a wide range of distances is not accidental, and it is natural to assume that this is due to the fact that the energy spectrum of the electron-proton cascade of age S, and the divergence of electrons, is entirely determined by Coulomb scattering. The lateral distribution of μ mesons was considered. μ mesons arise from the decay of π and K mesons in the upper layers of the atmosphere. According to experimental data the generation of μ mesons takes place in the altitude range from the point of generation to the level of observation without any interactions involving energy losses and lose their energy slowly on ionization of the air. (A.C.)

8025

ČERENKOV RADIATION OF EXTENSIVE AIR SHOWERS. A. E. Čudakov and N. M. Nesterova (P. N. Lebedev Physical Inst. of the USSR Academy of Sciences, Moscow). Nuovo cimento (10) 8, Suppl. No. 2, 606-11(1958).

Short light flashes superimposed on the background of the night sky glow, correlated with the passage of cosmic rays in the atmosphere, were first detected in 1952. It was established that at least some of these flashes were caused by Cherenkov radiation of extensive air showers. Further experiments were conducted in the Pamir mountains (altitude 386 m) in the autumn of 1955. The purpose of this investigation was to study the lateral distribution of the light flux relative to the core of the showers and also to determine the relation between the intensity of the light flashes and the size of the shower. The experimental arrangement included an optical receiver that registered the light flashes and a Geiger counter hodoscope. Two series of measurements were made. The sensitivity of the light receivers was adjusted so that about 100 pulses per hour were registered. On an average, each flash was accompanied by triggering of 20 hodoscope counters, while the number of cases when no counter was triggered was 4%. Thus it was established that practically all light flashes of a given intensity were produced by extensive air showers. (A.C.)

8026

COMBINED METHOD OF INVESTIGATION OF THE EXTENSIVE AIR SHOWERS. N. Dobrotin, O. Dovženko, et al. (P. N. Lebedov Physical Inst. of the USSR, Academy of Sciences, Moscow). Nuovo cimento (10) 8, Suppl. No. 2, 612-22(1958).

In order to reconstruct the picture of an elementary act of nuclear interaction at extremely high energies based on data of extensive air showers, it is necessary to make a detailed and comprehensive study of all the characteristics of the showers. Therefore, the investigation should be carried out with the use of a combined arrangement that will enable the investigators to determine (for any individual shower) not only the position of its axis and the total number of particles but to obtain all the characteristics of its different components. Tentative data are given concerning partial results of measurements carried out during the autumn of 1955 at an altitude of 3860 m (the Pamir Mountains, Central Asia) by workers of the Academy of Sciences of the USSR. The electronic arrangement used allowed the measurement of bursts in one chamber within the ionization interval (from 6×10^3 to 1×10^8 ion pairs), which corresponded to the ionization by the passage of 1 to 1.5×10^4 relativistic particles along its diameter and perpendicular to its axis. The master group of counters produced 60 master pulses per hour; 4×10^4 showers were recorded. The arrangement permitted the study of showers caused by primary particles with energies of 3×10^{13} to 2×10^{15} ev. (A.C.)

8027

THE M.I.T. AIR SHOWER PROGRAM. G. Clark, J. Earl, et al. (Massachusetts Inst. of Tech., Cambridge). Nuovo cimento (10) 8, Suppl. No. 2, 623-59 (1958).

A general description and preliminary results concerning the size of the spectrum and the zenith angle distribution are presented. The M.I.T. air shower program includes three experiments: (1) a preliminary experiment performed on the M.I.T. campus (latitude 42°N, sea level) by means of four detectors arranged at the vertices of a square 36 m on the side. (2) The "Agassiz experiment' which covers a circular area 460 m in diameter on the grounds of the Agassiz Astronomical Station of Harvard University (latitude 42°N, 183 m above sea level. (3) The "Kodaikanal experiment" using four detectors at the vertices of a square 35 m on the side in operation at Kodaidanal, India (latitude 8°N, 2800 m above sea level). Some results concerning the size spectrum and the zenith angle distribution are presented. The results on the arrival directions of air showers cover a range of primary energies from 10^{14} ev to 10^{18} ev and a range of celestial declinations from $-30°$ to $+80°$. Below primary energies of about 10^{17} ev, the data are consistent with the hypothesis that the primary flux is isotropic. Within statistical accuracy, this result is in agreement with results obtained in other experiments. On the other hand, the distribution of the arrival directions of showers with $N > 3 \times 10^7$, recorded by the large experiment, gives evidence of a lack of isotropy in the flux of primaries with energies greater than 10^{17} ev. (A.C.)

8028

THE SYDNEY AIR SHOWER EXPERIMENT. M. H. Brennan, J. A. Lehane, et al. (Univ. of Sydney). Nuovo cimento (10) 8, Suppl. No. 2, 653-61(1958).

Since February 1957 observations have been in progress in Sydney on extensive air showers of 10^5 to 10^7 particles. The following measurements are currently being made: (a) determination of shower size and core location, (b) directions of incidence of showers, (c) comparison between particle densities as measured by a scintillation counter and a tray of Geiger counters, (d) the lateral spread of high-energy μ mesons and low-energy nucleons, and (e) Cherenkov light pulses associated with showers. Results of measurements (a), (b), and (e) are reported. One of the calculations carried out by an electronic computer consists in computing the density of shower particles at various specified points in the array for each shower. The observed number of particles is plotted against the predicted number. There is good agreement between prediction and observation. The computer was used to predict the densities of "scintillation particles," densities of particles as would be measured by one of the scintillators, at the position of the unshielded tray of Geiger counters. A graphical representation is made with the predicted density of scintillator particles as ordinate and the number of Geiger counters discharged in each event as abscissa. It is apparent that the density of particles as measured by scintillators is not very different from that measured by a tray of Geiger counters. (A.C.)

8029

ČERENKOV LIGHT FROM AIR SHOWERS. M. H. Brennan, J. Malos, et al. (Univ. of Sydney). Nuovo cimento (10) 8, Suppl. No. 2, 662-4(1958).

Included in the Sidney experimental array is a Cherenkov detector. This detector consists of a searchlight mirror 110 cm in diameter, with aperture f/0.5, which is mounted to look vertically into the night sky. At the focus of the mirror are placed seven photomultipliers, one on the optic axis and the other six surrounding this central one. The apparatus is triggered on incident air showers rather than on incident light pulses. During the time of observation, 226 showers

were recorded which could be analyzed for shower size and for the position of the shower core. Of these 226 showers, 28 were accompanied by Cherenkov light pulses greater than the minimum acceptable size. For the 28 events no direct correlation between shower size and Cherenkov pulses was established. (A.C.)

8030

UNDERGROUND STUDIES OF μ-MESON COMPONENT IN EXTENSIVE AIR SHOWERS. M. Oda (Univ. of Tokyo). Nuovo cimento (10) 8, Suppl. No. 2, 665-7 (1958).

If detailed information on the μ-meson component is obtained, the development of the nucleon cascade in the atmosphere will be better understood. When the air shower hits the ground, there remain μ mesons which are not absorbed and penetrate into the ground. Observations at various underground depths have been made at various points. Results of experiments by Cornell, London, and Yaizer groups are summarized. The Cornell group found μ mesons with a sea-level energy of ~600 Bev penetrated ~1600 mwe. (A.C.)

8031

LATERAL DISTRIBUTION OF ENERGY FLOW OF CASCADE SHOWERS. J. Nishimura (Univ. of Tokyo). Nuovo cimento (10) 8, Suppl. No. 2, 672-4(1958).

In 1956 Oda (Institute of Nuclear Study, University of Tokyo) pointed out the possibility of observing the lateral distribution of the energy flow of shower particles using large Cherenkov detectors. A similar experiment was carried out by the Harwell group and reported at the Oxford Conference. An evaluation is made of the lateral distribution of energy flow of shower particles, using the solutions of lateral distribution functions reported in previous papers. (A.C.)

8032

TIME VARIATIONS OF EXTENSIVE AIR SHOWERS. A. Citron and G. Stiller (Univ. of Freiburg i. B.). Nuovo cimento (10) 8, Suppl. No. 2, 675-80(1958).

On the Schawinsland near Friedburg (48° N, 8° E, 1230 m) extensive showers were recorded from November 1953 to October 1956. The apparatus consists of 10 trays of G-M counters with an effective area of 1700 cm^2 each. Five of these trays (1 through 5) are located on a straight line at equal separations, the two extreme ones having a distance of 11 m. Three coincidences of the two outer and the center trays (1, 3, 5) and five coincidences of all five trays were recorded. Mean densities, counting ratios, estimated particle numbers, and energies for the various events are recorded. The counting rates were also calculated using the number spectrum of Greisen. Excellent agreement is found with the measured rates at low energies. A multiple correlation analysis between daily shower rates, local pressure, and free air temperature was carried out. It was found that partial correlation coefficients with respect to temperature vary little with the level at which the temperature is taken, provided one of the levels between 850 and 300 mb is chosen. (A.C.)

8033

FURTHER MEASUREMENTS ON EXTENSIVE AIR SHOWERS. K. Greisen (Cornell Univ., Ithaca, N. Y.). Nuovo cimento (10) 8, Suppl. No. 2, 681-3(1958).

A large experiment on extensive air showers was recently set up at Cornell University, similar to that at M. I. T., which employs 15 plastic scintillators. Five of the detectors are near the center of the array at spacings of 3 to 80 m. Five others are spaced about the center on a circle of 150-m radius, and the remaining five are on a circle of 500-m radius. The main component of the apparatus is a magnetic meson spectrometer located near the central counters. When a large shower occurs, a photograph is taken of a bank of 15 oscillograph tubes upon which all the scintillator pulses are registered. The times and heights of the pulses determine the direction and location of the shower axis and the size of the shower. If a meson has been recorded simultaneously, this fact and the approximate meson energy are registered on the same film by means of neon bulbs. With the oscilloscope method about 200 showers per day are examined. (A.C.)

8034

THE TEMPERATURE EFFECT OF EXTENSIVE AIR SHOWERS. L. Jánossy, T. Sándor, and A. Somogyi (Hungarian Academy of Sciences, Budapest). Nuovo cimento (10) 8, Suppl. No. 2, 701-9(1958).

The experimental arrangement used in studies of the temperature effect on air showers is shown, and the results of experimental measurements are given. These data indicate a temperature coefficient $B_t = 2.33 \pm 0.24\%$ per °C. The significance of this coefficient in previously collected shower intensity data is discussed. (D.E.B.)

8035

NUCLEON-NUCLEON INTERACTIONS AT ENERGIES GREATER THAN 10^{12} ev. Marcel Schein and D. M. Haskin (Univ. of Chicago). Nuovo cimento (10) 8, Suppl. No. 2, 710-13(1958).

An emulsion stack consisting of 100 sheets of Ilford G-5, 15 × 30 cm, and flown for 8 hr at 104,000 feet on a Skyhook balloon flight over Texas ($\lambda = 41°N$), was scanned for high-energy events. Two events seemed particularly suitable for analysis. The first event can be interpreted as a nucleon-nucleon interaction in which a high-energy proton collided with a hydrogen nucleus or a single proton on the periphery of a heavy nucleus. The angular distribution of the secondaries was measured, and the momentum of each individual track was determined by the measurement of multiple Coulomb scattering. It was found that particles in the central core of the shower carried such a high energy that the momentum could be determined only by using track-to-track scattering. Utilizing this method, moments up to about 100 Bev/c were measurable. Knowing the momenta and angular distribution of secondaries, it was possible to deduce a reliable estimate of the energy of the primary proton of 5×10^{12} ev. The average energy of the charged particles was only 1.4 Bev. The second event was found at a distance of 5.7 cm from the primary star, a neutral interaction consisting of a high-energy jet. The distance from the origin indicates the event was produced by a K^0, a neutron, or an antineutron. The energy and angular distributions were analyzed and indicated the neutral particles had an energy of 2×10^{12} ev. (A.C.)

8036

ONE CASE OF NUCLEAR INTERACTION IN PHOTOEMULSION AT THE ENERGY OF $\sim 5 \cdot 10^{13}$ ev/NUCLEON. I. M. Gramenizkij, G. B. Ždanov, et al. (P. N. Lebedev Inst. of Physics of the USSR Academy of Sciences, Moscow). Nuovo cimento (10) 8, Suppl. No. 2, 714-21(1958).

In a stack of stripped emulsions, exposed at 25.5 km in the autumn of 1955 in Italy, a rare case of nuclear interaction of very high energy was found. The principle characteristics of the interaction and their comparison with the hydrodynamical theory of multiple particle production are discussed. (A.C.)

8037

NUCLEAR INTERACTIONS BETWEEN 10^3 AND 10^5 Gev. B. Edwards, J. Losty, et al. (H. H. Wills Physical Lab., Bristol, Eng.). Nuovo cimento (10) 8, Suppl. No. 2, 722-4(1958).

A total of 23 liters of G5 emulsion was flown for about 6 hours at 100,000 feet, and seven liters were exposed for 0.5 year at 11,500 feet. Jets were detected by scanning the resulting soft cascades. This method imposed a lower limit on the primary energy of about 10^3 Bev. Twenty-four jets produced by protons and nine by α particles were obtained. The rate of events was 0.3 per liter-hour at high altitude and about 0.5 per liter-hour at mountain latitude. No cascade of multi-proton origin was observed. (A.C.)

8038

TWO INTERESTING CASES OF SECONDARY HIGH-ENERGY INTERACTIONS IN PHOTOGRAPHIC EMULSION. G. B. Ždanov, E. A. Zamčalova, et al. (P. N. Lebedev Physical Inst. of the USSR Academy of Sciences, Moscow). Nuovo cimento (10) 8, Suppl. No. 2, 726-9(1958).

Two events are described which were found in emulsions exposed in the stratosphere in the autumn of 1955 during an expedition in the Po valley. In the first case the interaction was apparently of the nucleon–nucleon type. From the emulsion tracks the angular distribution was measured, and the energy of the proton was found to be close to 2×10^{13} ev. This is 30 times the energy per nucleon in the primary particle. In the second case the nucleon interaction with secondary processes was caused by a heavy primary particle. From a study of the emulsion track the energy of the primary particle turns out to be 10^{14} ev/nucleon. Such a high value for the energy seems improbable. Thus the data show that the determinations of the energy of a primary by the assumption of the formation of a single system with symmetrical divergence of secondary particles in the center-of-mass system can lead to great errors. (A.C.)

8039

LARGE BURSTS INVESTIGATION AND HIGH ENERGY PARTICLES (10^{12} TO 10^{13} ev) INTERACTION WITH LIGHT NUCLEI. N. L. Grigorov, V. Y. Šestoperov, et al. (Moscow State Univ., Moscow). Nuovo cimento (10) 8, Suppl. No. 2, 730-2(1958).

Bursts at an altitude 3200 m above sea level were studied. The apparatus consisted of 44 ionization chambers made of brass. The chambers were filled with spectrally pure argon up to a pressure of 5 atmospheres. Only bursts are dealt with which were recorded simultaneously by two trays of chambers. The integral spectrum of such bursts in the interval from 600 to 6000 particles is represented by a formula. The data show that the probability for a burst to be accompanied by an air shower is 91 ± 5%. (A.C.)

8040

PHOTOGRAPHIC PLATES INVESTIGATION OF THE HIGH-ENERGY PARTICLES INTERACTION WITH LEAD NUCLEI. S. I. Brikker, N. L. Grigorov, et al. (Moscow State Univ., Moscow). Nuovo cimento (10) 8, Suppl. No. 2, 733-6(1958).

The lateral distribution of electrons in showers generated in lead by nuclear active particles of high energy was studied using electron-sensitive photographic plates. The plates were placed on a special apparatus under a 10 cm thick lead absorber. The apparatus consisted of two trays of ionization chambers having a length of 90 cm and a diameter of 4 cm. The experiment was performed at an altitude of 3200 m above sea level. The lateral distribution of particles in a shower is plotted for six high-energy events. Total particles in the events range from 403 to 1973. (A.C.)

8041

INVESTIGATION OF INTERACTION AT EXTREMELY HIGH-ENERGIES USING THE ANALYSIS OF EXTENSIVE AIR SHOWERS. A. E. Čudakov, N. A. Dobrotin, et al. (P. N. Lebedev Physical Inst. of the USSR Academy of Sciences, Moscow and Moscow State Univ., Moscow). Nuovo cimento (10) 8, Suppl. No. 2, 737-41 (1958).

Data from investigations of extensive air showers were analyzed and appear to allow certain conclusions concerning interaction cross sections and secondary particle energy and angular distributions in high-energy events. Equations for expressing these characteristics are given, and their variation with primary particle energy is discussed. (D.E.B.)

8042

ON THE NUMBER OF PARTICLES SPECTRUM OF EXTENSIVE AIR SHOWERS. G. B. Hristiansen and G. V. Kulikov (Moscow State Univ., Moscow). Nuovo cimento (10) 8, Suppl. No. 2, 742-5(1958).

Up to the present, mainly measurements of density spectra of extensive air showers were carried out. The number-of-particles spectrum of showers was obtained by recalculation from the obtained density spectrum. This method has serious disadvantages. In this investigation a direct study was made of the number-of-particles spectrum of showers. The measurements were carried out by means of the method of correlated hodoscopes. Using the hodoscope installation, it was possible to determine the position of the axis and the number of particles in showers with a total number from 2×10^4 to 2×10^6. The hodoscope system made it possible to determine the number of triggered counters in different groups of counters during the recording of each shower. Knowing the distribution of the counters that trigger in the plane of observation, it is possible, under certain assumptions, to find the number of particles and the coördinates of the axis in the plane of observation. (A.C.)

8043

ON THE MULTIPLE PRODUCTION OF PARTICLES IN WEAK INTERACTION OF NUCLEONS BY MEANS OF THEIR EXCITATION. G. T. Zacepin (P. N. Lebedev Physical Inst. of the USSR Academy of Sciences, Moscow). Nuovo cimento (10) 8, Suppl. No. 2, 746-8(1958).

The assumption has been made that ordinarily in the collision of nucleons formation of certain joined systems takes place into which enters the entire energy of the incident nucleon (or a considerable part of this energy), the subsequent break-up leading to the production of particles. When the energy of the colliding nucleon is high, there is another possible mechanism of multiple production of particles. The high-energy

nucleons exchange a small portion of their momenta and energy. During this process one or both of the nucleons become excited, and the excited state of the nucleons leads to the production of particles. The possibility of a new mechanism of multiple production of particles is discussed. (A.C.)

8044

ON THE THREE-DIMENSIONAL DEVELOPMENT OF AN ELECTRON-PHOTON CASCADE SHOWER. V. V. Gužavin and I. P. Ivanenko (Moscow State Univ., Moscow). Nuovo cimento (10) 8, Suppl. No. 2, 749-60(1958).

The problem of the three-dimensional development of a cascade shower can not be considered as completely solved. Because of the extraordinary complexity of the initial equations, the distribution function of particles has not been found. Such is also the case with an analytical expression for the function of spatial distribution. The functions of the angular and lateral distribution of particles in the shower were constructed from the moments by the method of graphical selection of an arbitrary function; the first several moments coincide with the precise ones. It appears that this method is promising for solving these problems. A mathematical analysis of the problem using the method of moments is given. (A.C.)

8045

STUDIES ON TRANSVERSE MOMENTA OF HIGH-ENERGY JETS WITH EMULSION CLOUD CHAMBERS. Nuovo cimento (10) 8, Suppl. No. 2, 761-9(1958).

It has been suggested that transverse momenta of shower particles with respect to the shower axis are important quantities in the study of high-energy jet-shower dynamics. The experimental data are tabulated. The transverse momenta of secondaries are quite small even when the primary and secondary energies are very high, and they seem to be insensitive to the energy or primary particles. An emulsion chamber project was recently carried out with the collaboration of several laboratories to get further experimental information on transverse momenta of shower particles. Seventeen emulsion chambers were flown by 8 plastic balloons to a height of 5600 m and 13 of them were recovered. From 2 to 4 jets of more than 3 cores with good separation were found in each chamber. The development of a separated cascade shower was inspected. By comparing its transition curve with the theoretical one, the energy of the primary γ ray of each shower may be estimated. (A.C.)

8046

ON SOME INTERACTION CHARACTERISTICS OF VERY HIGH-ENERGY PARTICLES AND THEIR INTERPRETATION FROM THE VIEWPOINT OF THE HYDRODYNAMICAL THEORY OF MULTIPLE PARTICLES PRODUCTION. G. A. Milečin and I. L. Rozenthal' (P. N. Lebedev Inst. of Physics of the USSR Academy of Sciences, Moscow). Nuovo cimento (10) 8, Suppl. No. 2, 770-4(1958).

Landau, using the idea stated by Fermi, employed relativistic hydrodynamics in describing very high energy particle collision. The first attempts to compare the conclusions of hydrodynamical theory with experimental data on the multiplicity and angular and energy distributions of secondary particles already showed that the hydrodynamical theory satisfactorily described many multiple process characteristics. By comparison of the theory with experimental data taken from the analysis of showers recorded in photographic emulsion, a number of essential additional assumptions were made. These assumptions caused a certain obscurity of the conclusions. For example, it was assumed that the collision of nucleons with heavy nuclei took place in the coördinate system in which notion of substance was symmetrical. Extensive shower analysis carried out on the assumption that the nuclear interaction cross section is independent of energy shows that the formal part of the hydrodynamical theory is incomplete. (A.C.)

8047

MULTIPLE PRODUCTION OF PARTICLES IN JETS. D. S. Černavskij (P. N. Lebedev Inst of Physics of the USSR Academy of Sciences, Moscow). Nuovo cimento (10) 8, Suppl. No. 2, 775-85(1958).

Jets observed in photoemulsions are due to interaction of nucleons of high energy ($>10^{10}$ ev). The following cases are possible: (1) interaction of a nucleon with internal parts of a heavy nucleus; (2) head-on interaction of a nucleon with one of the surface nucleons of the nucleus, and (3) peripheric interaction of a nucleon with a nucleon. When a collision of a nucleon with a nucleon occurs, the nucleon cuts a tunnel in the nucleus and interacts only with that nucleon. It is shown that the classical treatment of peripheric interactions of two nucleons is not adequate and that it is necessary to take into account the quantum structure of the field. The problem of peripheric interaction of two nucleons is reduced to the problem of head-on interaction of a nucleon with a meson. The nucleons flying past each other exchange mesons. The energies (and meson momenta) which are exchanged by the nucleons may vary within the limits of the spectrum which is determined by the development of $\Psi(r)$ in a Fourier series. (A.C.)

8048

EXPLOSIVE SHOWERS PRODUCED BY HIGH-ENERGY COSMIC-RAY PARTICLES. I. I. Gurevič, A. P. Mišakova, et al. (Academy of Sciences, Moscow). Nuovo cimento (10) 8, Suppl. No. 2, 786-92(1958).

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 9250.

8049

THEORETICAL INTERPRETATION OF MULTIPLE PRODUCTION OF PARTICLES IN HIGH ENERGY COLLISIONS. G. Wataghin (Univ. of Turin). Nuovo cimento (10) 8, Suppl. No. 2, 793-5(1958).

A theoretical approach to the interpretation of the multiple production of particles on the basis of a nonlocal field theory is proposed. A formalism is sketched which provides the necessary tools for a field theoretical interpretation of multiple production. (A.C.)

8050

COSMIC RAY NEUTRON STUDIES. S. A. Korff (New York Univ., University Heights). Nuovo cimento (10) 8, Suppl. No. 2, 796-800(1958).

A neutron monitor was installed in Alaska in connection with New York University's IGY program. The monitor is of the standard Simpson type using 12 counters in a paraffin and lead pile. The monitor is located 6 miles NW from Fairbanks, Alaska (geographic latitude 65°N, longitude 148°W). The counters and barometer are photographed every 15 minutes. Only the largest fluctuations are presented. These are so large that they far outweigh the pressure variations, and hence it does not matter whether the pressure coefficient is applied or not. On January 21 to 27, 1957, there was a

decrease of 15 or 20% which apparently was world wide. It correlates with magnetic and ionospheric disturbances. An increase of the order of 25% was observed on December 30, 1956, which returned to normal in about 20 minutes. A series of large irregularities started on March 2 to 4, 1957, in which irregular increases of the order of 50 to 100% occurred over a period of several days. This also correlates with geomagnetic and ionospheric disturbances and auroral displays. In connection with the problem of neutron balance there is a discussion of the mechanisms of neutron production. (A.C.)

8051

PREHISTORIC COSMIC RAY INTENSITY. P. S. Goel, D. P. Kharkar, et al. (Tata Inst. for Fundamental Research, Bombay). Nuovo cimento (10) 8, Suppl. No. 2, 801-4(1958).

The only determinations of past cosmic-ray intensity were based on studies of cosmic-ray-produced C^{14}. These studies have shown that up to 10,000 to 15,000 years ago, the cosmic-ray intensity was the same within ±10%. The measurements of Kulp and Volchok on C^{14} concentration in sections of ocean sediments showed the cosmic-ray intensity remained substantially constant in the last 30,000 years. These results, however, depend on the validity of ionium age determination method and have recently been criticized. Two years ago it was pointed out that the 2.7 million year half life Be^{10}, which is produced mainly in interactions of cosmic rays with atmospheric nitrogen nuclei, may finally accumulate in deep sea sediments and should be detectable in regions of small sedimentation rates. If such sediments can be found which have remained undisturbed in the past, its studies should yield the cosmic-ray intensity up to 10 million years in the past. Beryllium-10 has been detected in deep Pacific sediments and its concentrations analyzed in the upper and lower ends of 14-meter sediment core. The experimental procedure and results are described. The present day global deposition of Be^{10} was calculated from the available cosmic-ray and accelerator data and also estimated from the observed deposition rate of another cosmic-ray-produced isotope, Be^{7}. The two estimates agree on the present day deposition rate of 2.3×10^{6} Be^{10} nuclei $cm^{-2}year^{-1}$. The results are therefore consistent with a constant cosmic-ray intensity up to ~2 million years. (A.C.)

8052

A DECAY OF AN ANTI-HYPERON, $\overline{\Lambda^0}$, IN NUCLEAR EMULSION. D. J. Prowse (Univ. of California, Los Angeles) and M. Baldo Ceolin (Univ. of Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo cimento (10) 10, 635-45(1958) Nov. 16.

An event found in a stack of nuclear emulsion exposed to 10^6 4.6 Bev π^- mesons per cm^2 was interpreted as an example of the decay in flight of an antihyperon, $\overline{\Lambda^0}$. The event and the interpretation are discussed in detail. (auth)

8053

DECAYS OF HYPERFRAGMENTS IN NUCLEAR EMULSION. C. Grote (Deutsche Akademie der Wissenschaften and Kernphysikalisches Institut, Berlin). Nuovo cimento (10) 10, 652-8(1958) Nov. 16.

Seven decays of hyperfragments were found in Ilford G-5 emulsion. Five events are uniquely defined decays. Within the limits of error the binding energies agree with the results of other authors. (auth)

8054

THE POLARIZATION OF KNOCK-ON ELECTRONS ARISING FROM SCATTERING BY POLARIZED μ-MESONS. D. Fivel and T. Fulton (Johns Hopkins Univ., Baltimore). Nuovo cimento (10) 10, 682-7(1958) Nov. 16.

An experiment is proposed for the direct measurement of the helicity of μ mesons arising from π decay by studying the polarization of the high-energy electrons produced in the collision of the polarized μ mesons with unpolarized electrons. Polarization effects become significant only for high-energy incident μ's (of the order of a few Bev). The separation of a polarized beam of μ mesons from the decays in flight of high-energy π's is in principle made easier by the fact that the laboratory momenta of μ mesons which are emitted in the forward and backward directions in the π rest system differ by about 42% as a consequence of the relativistic transformation from the center of mass to the laboratory system. Expressions in the laboratory frame are also given of the cross section for scattering polarized electrons by polarized μ mesons. In the C.M. frame, the results agree with those calculated by Bincer. (auth)

8055

THE RADIATIVE PION-NUCLEON SCATTERING IN STATIC THEORY. B. Bosco (Univ. of Turin and Istituto Nazionale di Fisica Nucleare, Turin) and R. Stroffolini (C.N.R.N., Naples). Nuovo cimento (10) 10, 688-97 (1958) Nov. 16.

Radiative pion-nucleon scattering is studied in static theory treating one meson exactly and the other one in the one-meson approximation. Explicit expressions for the rescattering corrections are obtained. (auth)

8056

SELF-ENERGY OF THE LONGITUDINAL NEUTRINO. W. W. Wada (U. S. Naval Research Lab., Washington). Nuovo cimento (10) 10, 728-9(1958) Nov. 16.

It is shown that the self-energy of the longitudinal neutrino, arising from the interaction involving four fermions, vanishes in the lowest order perturbation calculation by virtue of the neutrino gage. (A.C.)

8057

PION-PROTON SCATTERING DISPERSION RELATIONS. L. Bertocchi and L. Lendinara (Univ. of Bologna and Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo cimento (10) 10, 734-8(1958) Nov. 16.

Pion–proton scattering was investigated, and the results were compared with results previously reported by Puppi and Stanghellini. Differences in the two sets of data are attributed to the use of different values for the π^--p total cross sections at low energies. (D.E.B.)

8058

POLARIZATION NEAR THE HIGH-FREQUENCY LIMIT OF 500-kev BREMSSTRAHLUNG. J. W. Motz and R. C. Placious (National Bureau of Standards, Washington). Phys. Rev. 112, 1039-40(1958) Nov. 15.

The angular dependence of the linear polarization near the high-frequency limit of the bremsstrahlung spectrum for 500-kev electrons was measured with a polarimeter that depends on the polarization sensitivity of the Compton process. The results confirm the polarization reversal predicted at large angles by the Gluckstern-Hull-Breit caculations, and are consistent with the reversal found in the photoelectric measurements of McMaster and Hereford. (auth)

8059

STATISTICAL MECHANICS OF COUPLED PARTICLES IN THE SCHRÖDINGER REPRESENTATION. Robert H. Kraichnan (New York Univ.). Phys. Rev. 112, 1056-7 (1958) Nov. 15.

A perturbation treatment is presented for the operator u(t) giving the evolution of the state vector of a system of N particles coupled by 2-body forces. The total hamiltonian is divided into a diagonal part H_0 and off-diagonal part H_1 in the representation with N-particle plane-wave states as basis. An effective pair-interaction operator $\bar{H}_1$ is defined which includes vertex corrections of all orders, and the off-diagonal part of u is expressed exactly by an expansion which involves only $\bar{H}_1$ and the exact diagonal part of u. A closed set of equations determining $\bar{H}_1$ and the diagonal part of u are obtained by retaining only the leading terms in the expansion. These equations include all the corrections included in the Brueckner approximation and, in addition, they contain 3-body effects, iterated to all orders, which are omitted in that approximation. No one-to-one correspondence between the eigenstates of H_0 and those of the total hamiltonian is appealed to, and the ground state plays no special role. The connection with statistical mechanics follows the fact that the partition function is $Tr[u(-i/kT)]$. The theory simplifies greatly for very large N. (auth)

8060

STATISTICAL MECHANICS OF COUPLED BOSONS IN THE HEISENBERG REPRESENTATION. Robert H. Kraichnan (New York Univ.). Phys. Rev. 112, 1054-5 (1958) Nov. 15.

A system of bosons interacting by 2-body forces is treated in momentum space in the Heisenberg representation, assuming a statistically homogeneous and stationary state. The principle of weak statistical dependence of different momentum modes, previously applied to turbulence dynamics, is used to obtain an exact expansion expressing quadrilinear (2-body) time-displaced correlation functions of the second-quantized field variables in terms of bilinear time-displaced correlation functions and average impulse-response functions. The last-named functions are defined in terms of the exact Green's operator, for infinitesimal sources, of the nonlinear Heisenberg equations of motion. A set of coupled integral equations are then obtained which determine both the bilinear correlation functions and the response functions. By retaining in these equations only the lowest terms in the cited expansion, a theory is obtained which includes particle self-energy interactions with the medium of all orders. A modification of the theory is briefly outlined which includes, at finite temperatures, all the processes described at absolute zero by the Brueckner approximation and, in addition, 3-body effects, iterated to all orders, which are omitted in that approximation. (auth)

8061

EXPERIMENTAL RANGE OF PROTONS IN Al. Hans Bichsel (Rice Inst., Houston, Texas). Phys. Rev. 112, 1089-91(1958) Nov. 15.

The ranges of protons of 1 to 6 Mev in Al were determined experimentally. Combining these results with earlier experimental data, the range can be represented by the following analytic functions: for $1 < E < 2.7$ Mev, $R = 3.837\ E^{1.5874}$; for $2.7 < E < 20$ Mev, $R = 2.837\ E^2/(0.68 + \log_{10}E)$, with E in Mev and R in mg/cm^2. A tentative comparison with the theory of stopping power was made. The neutron thresholds for proton bombardment of C^{13}, F^{19}, and Na^{23} were obtained as an incidental result. (auth)

8062

LOW-ENERGY SPUTTERING YIELDS IN Hg. Gottfried K. Wehner (General Mills, Inc., Minneapolis). Phys. Rev. 112, 1120-4(1958) Nov. 15.

Further data on sputtering yields for normally incident Hg^+-ion bombardment in the energy range of 50 to 400 ev have been collected. Experimental data are used to determine the influence of atomic weight and heat of sublimation of the target material and to establish an empirical sputtering relation. Results provide strong support for a picture of sputtering which might be termed playing three-dimensional billiards with atoms. The degree of filling of the inner shells, especially the d shells, determines how closely collisions approximate hard-sphere collisions. Energy is transferred most efficiently in metals with completely filled d shells. Accordingly, Cu, Ag, and Au have the highest sputtering yields. Results for Hg^+-ion bombardment support theories developed by Langberg and by Silsbee but disagree with a theory published by Henschke. Conditions may be different, however, for the case of bombardment with light ions such as hydrogen or helium. The sputtering yields of alloys do not seem to differ substantially from those of their main constituents. (auth)

8063

POLARIZATION OF PROTONS FROM $C^{12}(d,p)C^{13}$ REACTION WITH DEUTERONS OF 1060 kev. Mira K. Jurić and Silva D. Ćirilov (Inst. of Nuclear Science, Boris Kidrich, Belgrade). Phys. Rev. 112, 1224-6 (1958) Nov. 15.

The polarization of protons from the $C^{12}(d,p)C^{13}$ reaction was measured for a deuteron energy of 1060 kev at angles 20 and 140°. Elastic scattering by carbon was used to analyze the polarization. Nuclear emulsions were used as the proton detector. The observed magnitude of the polarization was found to be $P = 54.3 \pm 9.5\%$ at 20° and $P = 29.4 \pm 12.6\%$ at 140°. Positive sign of the polarization corresponds to the vector product $K_p \times K_d$. (auth)

8064

BETA-GAMMA CORRELATION AND TIME-REVERSAL INVARIANCE. Icko Iben, Jr. (Univ. of Illinois, Urbana). Phys. Rev. 112, 1240-6(1958) Nov. 15.

The distribution function for the first-forbidden beta-gamma correlation for randomly oriented nuclei, including beta transverse polarization terms, is presented and discussed in connection with the question of time-reversal invariance. Coulomb field effects are included and it is found that even for relatively small Z the time-reversal testing asymmetry is reduced appreciably compared to that calculated for Z = 0 by Curtis and Lewis. In the limit of high ($\alpha Z/2R$), that is, for most first-forbidden decays, a definite relation exists between the ordinary directional correlation asymmetry and the beta polarization-dependent asymmetries. In this approximation it is found that terms which test time-reversal invariance appear in the same manner in all asymmetries but are dominated in general by contributions which do not test time-reversal invariance. For the particular case of Au^{198} it is shown that the experimental results are consistent with time-reversal invariance but are also consistent with an appreciable violation of time-reversal invariance. It is concluded that under favorable conditions it is barely possible that

an investigation of the asymmetries for some other beta-gamma cascade could provide a test for time-reversal invariance. However, the extent to which this invariance is or is not violated could not be determined by such an investigation. (auth)

8065

$\pi^+ - p$ INTERACTIONS IN THE ENERGY RANGE AROUND 500 Mev. M. E. Blevins, M. M. Block, and J. Leitner (Duke Univ., Durham, N. C.). Phys. Rev. 112, 1287-94(1958) Nov. 15.

A hydrogen-filled diffusion cloud chamber investigation of $\pi^+ - p$ interactions in the energy range around 500 Mev is reported. The elastic scattering angular distribution, based on a total of 180 events, is analyzed using only s and p waves, and also using s and p waves with a d-wave interference term. Phase shifts are presented and ambiguities are discussed. The d-wave contribution is small. The elastic cross section is used to compute the real part of the forward coherent scattering amplitude. The latter is in good agreement with that predicted by the dispersion relations. Inelastic production sets in at about 300 Mev. Eighteen inelastic events were found; 7 were $p + 0$, 7 were n^{++}, and 4 were unidentifiable. Inelastic processes are discussed in terms of various models. (auth)

8066

ANTIPROTON-PROTON CROSS SECTIONS AT 133, 197, 265, AND 333 Mev. Charles A. Coombes, Bruce Cork, et al. (Univ. of California, Berkeley). Phys. Rev. 112, 1303-10(1958) Nov. 15.

In a scintillation-counter experiment the interaction of antiprotons with protons in the energy region 133 to 333 Mev was studied. Antiprotons, produced internally in the Bevatron, channeled externally by a system of magnetic quadrupoles and bending magnets, and identified by time of flight, entered a target containing liquid hydrogen. This target was completely surrounded by a system of scintillation counters which detected both scattered antiprotons and annihilation secondaries. An electrostatic-magnetic velocity spectrometer was used in the external magnetic channel to increase the ratio of antiprotons to pions. The $\bar{p} - p$ total, elastic, inelastic, and charge-exchange cross sections, and the angular distribution of elastic scattering were measured at each energy. The inelastic cross section is approximately one-half the total cross section at these energies. The results are discussed in connection with current theories. (auth)

8067

YIELDS OF K^+ AND K^- MESONS PRODUCED BY 1.7- TO 3-Bev PROTONS. J. Hornbostel, E. O. Salant, and G. T. Zorn (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 112, 1311-18(1958) Nov. 15.

Nuclear emulsions were used to measure yields of K^+ and K^- mesons produced in Be (and Pb) nuclei by Cosmotron protons of various energies, ranging from 1.7 Bev to 2.95 Bev. The experimental equipment accepted particles emitted in the forward direction with momenta of about 300 Mev/c. At 2.95 Bev, the K^+ yield from Be corresponds to a differential cross section per nucleus of $(4.0 \pm 0.5) \times 10^{-31}$ cm^2(Mev/c)$^{-1}$ sterad^{-1}; the K^- cross section is 26 times smaller. The K^+ cross section of Pb is larger than that of Be by a factor approximately equal to the ratio of the geometric cross sections of these nuclei. With decreasing proton energy, the K^- yield falls more rapidly than the K^+ yield. The energy dependence of the yields was compared with curves which were computed, on the assumption of constant matrix elements, from the phase-space factors of production reactions required by the principle of conservation of strangeness. For K^-, the results of these calculations agree with the experimental data; for K^+, the yield falls more rapidly with decreasing primary energy than expected from the computations. (auth)

8068

QUASI-ELASTIC SCATTERING OF PIONS BY NUCLEI. T. K. Fowler (Univ. of Wisconsin, Madison). Phys. Rev. 112, 1325-35(1958) Nov. 15.

A prescription is discussed for estimating the inelastic contamination generally present in attempted measurements of elastic pion-nucleus differential scattering cross sections because of the finite energy resolution of detectors. It is also pointed out that in such quasi-elastic measurements the interference portion of the inelastic scattering, for which the form factor is the Fourier transform of the important and unknown nucleon pair correlation density, is experimentally separated from the direct inelastic scattering over a large range of scattering angles. (auth)

8069

π^+-MESONIC DECAY OF A HYPERFRAGMENT. J. Schneps (Tufts Univ., Medford, Mass.). Phys. Rev. 112, 1335-6(1958) Nov. 15.

The π^+-mesonic decay of a hyperfragment has been observed. The hyperfragment was produced in a negative K-meson star in emulsion, and it decayed into two visible particles, a π^+-meson and a recoil. It can be interpreted as ${}_\Lambda Li^7 \rightarrow n + \pi + He^6$, or ${}_\Lambda Be^7 \rightarrow n + \pi^+ + Li^6$. Since the Λ particle decays only into $p + \pi^-$ and $n + \pi^0$, the appearance of π^+-meson from this hyperfragment is explained as due to the charge exchange of a π^0-meson from the Λ decay with the residual nucleus of the hyperfragment. (auth)

8070

SCATTERING OF 31.5-Mev POSITIVE PIONS FROM CARBON. P. P. Kane (Univ. of Rochester, N. Y.). Phys. Rev. 112, 1337-43(1958) Nov. 15.

Measurements were made at laboratory angles from 40 to 145° on the scattering of 31.5-Mev positive pions from carbon. Pulse-height analysis was used to select elastic scattering events. The observed differential cross sections for elastic scattering indicate destructive interference between the Coulomb and nuclear scattering amplitudes. The presence of inelastic pion scattering is inferred from a combination of different methods of study: pulse-height analyses, absorption measurements, and detailed comparisons of the data obtained in the case of carbon with those obtained in the case of copper and lead. An upper limit of 2 is placed on the spin of the 9.6-Mev state of C^{12}. This is not in disagreement with the results of other experiments and existing theoretical predictions. (auth)

8071

DETERMINATION OF THE PION-NUCLEON SCATTERING AMPLITUDE FROM DISPERSION RELATIONS AND UNITARITY. GENERAL THEORY. S. Mandelstam (Columbia Univ., New York). Phys. Rev. 112, 1344-60 (1958) Nov. 15.

A method is proposed for using relativistic dispersion relations, together with unitarity, to determine the pion-

nucleon scattering amplitude. The usual dispersion relations by themselves are not sufficient, and a representation is assumed which exhibits the analytic properties of the scattering amplitude as a function of the energy and the momentum transfer. Unitarity conditions for the two reactions $\pi + N \rightarrow \pi + N$ and $N + \bar{N} \rightarrow 2\pi$ will be required, and they will be approximated by neglecting states with more than two particles. The method makes use of an iteration procedure analogous to that used by Chew and Low for the corresponding problem in the static theory. One has to introduce two coupling constants; the pion-pion coupling constant can be found by fitting the sum of the threshold scattering lengths with experiment. It is hoped that this method avoids some of the formal difficulties of the Tamm-Dancoff and Bethe-Salpeter methods and, in particular, the existence of ghost states. The assumptions introduced are justified in perturbation theory. As an incidental result, we find the precise limits of the region for which the absorptive part of the scattering amplitude is an analytic function of the momentum transfer, and hence the boundaries of the region in which the partial-wave expansion is valid. (auth)

8072

DISPERSION RELATIONS FOR PION-PROTON SCATTERING. D. A. Geffen (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev. 112, 1370-5(1958) Nov. 15.

The dispersion relations are used to predict the values at zero kinetic energy, of the derivatives, $\partial D_+(0)/\partial k^2$, of the real parts, $D_+(0)$ and $D_-(0)$, of the forward elastic scattering amplitudes for π^+ and π^- mesons scattered by protons. The experimental value of $\partial D_+(0)/\partial k^2$ is fairly well known, and, when compared with the predicted value, yields a determination of the coupling constant, $f^2 = 0.104 \pm 0.014$. The predicted value for $\partial D_-(0)/\partial k^2$ disagrees badly with experiment, especially with an f^2 as large as 0.10. The dispersion relations are modified by introducing an extra energy denominator in such a way as to contain, as the additional constants, the derivatives $\partial D_\pm(0)/\partial k^2$. This enables us to check the values of $\partial D_\pm(0)/\partial k^2$ obtained from the usual dispersion relations as well as the assumption that $\omega^{-2}T_\pm(\omega)$ vanishes at infinity. It is found that as long as the agreement with experiment obtained for the π^+ relation is retained, no appreciable change in the values of $\partial D_\pm(0)/\partial k^2$ is possible and that the high-energy behavior of $T_\pm(\omega)$, usually assumed, is correct. The predicted value for $\partial D_-(0)/\partial k^2$ strongly suggests a nonzero effective range for α_1 and a relatively large α_{11}. (auth)

8073

PROPOSAL FOR DETERMINING THE PION-NUCLEON COUPLING CONSTANT FROM THE ANGULAR DISTRIBUTION FOR NUCLEON-NUCLEON SCATTERING. Geoffrey F. Chew (Univ. of California, Berkeley). Phys. Rev. 112, 1380-3(1958) Nov. 15.

A plausibility argument is made that the real and imaginary parts of the nucleon-nucleon scattering amplitude as a function of the cosine of the barycentric system scattering angle, for fixed energy, are analytic in the complex plane, with singularities confined to the real axis. It is conjectured that in the real part there are poles at $\cos\theta = \pm(1 + \mu^2/2k^2)$, where μ is the pion rest mass and k the barycentric momentum, branch points at $\cos\theta = \pm(1 + 2\mu^2/k^2)$, $\pm(1 + 9\mu^2/2k^2)$, etc. The residues of the poles are related directly to g^2, the pion nucleon coupling constant, and a procedure is outlined for determining g^2 by an extrapolation of experimental data on either backward or forward nucleon-nucleon scattering. (auth)

8074

WIDE-ANGLE PAIR PRODUCTION AND QUANTUM ELECTRODYNAMICS AT SMALL DISTANCES. J. D. Bjorken, S. D. Drell, and S. C. Frautschi (Stanford Univ., Calif.). Phys. Rev. 112, 1409-17(1958) Nov. 15.

Wide-angle photoproduction of high-energy electron-positron pairs in hydrogen is proposed and analyzed as a test of quantum electrodynamics at distances $\lesssim 10^{-13}$ cm. The effect of proton structure can be removed in terms of the two form factors measured in the elastic electron-proton scattering process. Cross sections are presented for two classes of pair production experiments: (1) those detecting one of the final particles and (2) coincidence experiments. In addition to kinematic, anomalous moment, and nucleon form-factor corrections to the Bethe-Heitler formula dynamical corrections to the proton current and radiative corrections are calculated. The final theoretical formula is believed to be accurate to 2%. A simple cutoff model suggests that a 5% accuracy in an experiment of type (1) tests the electron propagator at distances $\sim 0.7 \times 10^{-13}$ cm, while a 10% accuracy in a coincidence arrangement of type (2) probes the electron propagator at $\sim 0.3 \times 10^{-13}$ cm. (auth)

8075

SUPRATHERMAL PARTICLES. III. ELECTRONS. E. N. Parker (Univ. of Chicago). Phys. Rev. 112, 1429-35(1958) Dec. 1.

Certain phenomena in nature, such as the 50- to 100-kev electrons of the aurora, suggest that there are plasma-dynamical processes which can quickly transfer the translational energy of the ions in a plasma stream to the electrons (some 20 kev/ion for a 2000-km/sec solar wind). It is shown that two interpenetrating streams of noncolliding and initially neutral plasma can achieve this energy transfer with a characteristic time comparable to $(M/m)^{1/2}$ times the plasma period. The process is closely analogous to the excitation of plasma oscillations by two interpenetrating electron streams, but of course proceeds to much greater electron energies because the ion components of the streams carry so much more kinetic energy than do the electron components. Hence, besides the auroral electrons, it is probably responsible for solar radio emission, rather than the electron streams implied in current theories. Further, the process is probably the dominant interaction in shock fronts, particularly in astrophysical cases where neither direct collisions nor the existing weak magnetic fields can give sharp fronts. The characteristic thickness of a shock front in the solar wind is of the order of 10^4 cm due to the above plasma excitation whereas the Larmor radius of the ions, which would otherwise determine the shock thickness in the absence of collisions, is 100 km or more. (auth)

8076

SOME ATOMIC EFFECTS OF AN ELECTRONIC ELECTRIC DIPOLE MOMENT. E. E. Salpeter (Cornell Univ., Ithaca, N. Y.). Phys. Rev. 112, 1642-8(1958) Dec. 1.

A parity-violating perturbation, corresponding physically to a permanent electric dipole moment of an electron parallel to its spin, is introduced into the Dirac equation for an electron. For positrons two choices of the relative sign of electric moment and spin are considered. Some numerical consequences of such a

perturbation for hydrogenic atoms and for positronium are calculated. From various experiments carried out previously, rough upper limits are obtained for ξ, the electric dipole moment expressed in units of $e\hbar/mc$: From the numerical value of the Lamb shift, $\xi < 0.004$; from the metastability of the 2s-state in hydrogen, $\xi < 0.03$. From the absence of $K \rightarrow L_I$ x-ray transitions in the heaviest atoms, the upper limit for ξ is about 0.005 or, probably, even smaller. From the value of the hyperfine splitting of the positronium ground state, $\xi < 0.02$. (auth)

8077

COULOMB EXCHANGE ENERGY FROM SHELL-MODEL WAVE FUNCTIONS. N. V. V. J. Swamy (Florida State Univ., Tallahassee) and A. E. S. Green (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 112, 1719-21(1958) Dec. 1.

The Coulomb direct and exchange energies of several light nuclei were calculated by using harmonic-oscillator wave functions and approximate wave functions for a realistic diffuse-boundary potential. The Z dependence of the total exchange energy is expressed in terms of a convenient parameter c. Calculations show that for a very low Z this parameter is appreciably smaller than a prior estimate by Bethe and Bacher based upon the statistical model, but that it rapidly reaches their value $5(3/16\pi)^{2/3}$ for $Z \gtrsim 10$. (auth)

8078

NEUTRAL DECAY MODES OF THE θ_1^0 AND Λ^0. Elihu Boldt, Herbert S. Bridge, David O. Caldwell, and Yash Pal (Massachusetts Inst. of Tech., Cambridge and Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 112, 1746-9(1958) Dec. 1.

In a large multiplate cloud chamber, an event was found which strongly indicates that the decay mode $\theta_1^0 \rightarrow 2\pi^0$ exists, and therefore that the spin of the K meson is even. Two showers are seen which, from their spatial angles and energies, must represent essentially the whole energy of the two π^0's from a θ_1^0 produced in association with a Λ^0. On the basis of this event, the fraction of θ_1^0 decays going by the $2\pi^0$ mode is ~0.06, and the probability that this fraction could be consistent with the value of $\frac{1}{3}$ predicted by $\Delta I = \frac{1}{2}$ selection rule is 3%. Furthermore, the chance that the observed ratio is $\geq \frac{1}{4}$, a value possible with an admixture of $\Delta I = \frac{3}{2}$, is 10%. Our observation of single shower events attributable to $\theta_1^0 \rightarrow 2\pi^0$ give even smaller probabilities that the fraction of neutral decays is as large as $\frac{1}{3}$ or $\frac{1}{4}$, but the necessity of a background subtraction makes these results less significant. On the other hand, the fraction of Λ^0 decays going by a neutral decay mode is quite consistent with the value of $\frac{1}{3}$ predicted by the $\Delta I = \frac{1}{2}$ rule. The values obtained for this fraction are 0.22 ± 0.13 from the direct observation of showers (presumably from $\Lambda^0 \rightarrow n + \pi^0$), and 0.33 ± 0.06 from the number of Λ^0's not decaying by the charged mode. (auth)

8079

VARIATIONS IN THE COSMIC-RAY NUCLEONIC INTENSITY. J. A. Lockwood (Univ. of New Hampshire, Durham). Phys. Rev. 112, 1750-8(1958) Dec. 1.

The monthly mean intensity of the nucleonic component of cosmic radiation measured at Mt. Washington, geographic latitude 44.2°N and elevation 6262 ft, decreased 22% from July, 1954 to December, 1957. The decreased intensity now prevailing came about through a series of sudden decreases from which only partial recovery occurred. During this same period, the amplitude of the day-to-day intensity changes has increased. A study was made of the largest Forbush-type decreases which have occurred in this interval. Many of these intensity drops have a decrease rate ~1.5% hr^{-1}, with a maximum rate of 2.5% hr^{-1}. In some cases they are preceded by a slight increase of ~1.5%. These decreases do not have a similar time dependence. There is no apparent 27-day recurrent tendency for these sudden drops. The energy dependency of these events is variable. The restrictions which these decreases impose upon the existing models of solar modulation mechanisms are discussed. (auth)

8080

SUPRATHERMAL PARTICLE PRODUCTION BY BINARY STARS. D. A. Tidman (Univ. of Chicago). Phys. Rev. 112, 1759-62(1958) Dec. 1.

It is suggested that the expanding coronas of binary stars collide and produce a region in violent motion capable of accelerating ions by the Fermi mechanism. This may be important for injecting low-energy cosmic radiation into the interstellar medium. (auth)

8081

SCATTERING OF 80-Mev π^- MESONS BY COMPLEX NUCLEI. W. F. Baker and J. Rainwater (Columbia Univ., New York) and R. E. Williams (Paul Rosenberg Associates, Mount Vernon, N. Y.). Phys. Rev. 112, 1763-72(1958) Dec. 1.

The elastic scattering of 80-Mev π^- mesons by lithium, carbon, aluminum, and copper was investigated using a π^- detector which gives improved discrimination against low-energy-loss inelastic events. A "transmission" scatterer orientation was necessary to maintain energy resolution, so only less than 120° scattering was studied. The new differential scattering cross sections for lithium, aluminum, and copper agree with the previously reported results at small angles but are 2 to 10 times smaller at larger angles. There are indications of diffraction structure in aluminum and copper which were not previously observed due to the poorer energy resolution of the earlier measurements. Including the incident beam energy spread, the detector sensitivity is down by factors of 3 and 9 for $E \pm 5.0$ and $E \pm 10$ Mev when peaked for mean energy E. This was used to separate the scattering from carbon into elastic and inelastic components for excitation of the 4.43 and (7.65 and 9.61) Mev levels. Inelastic scatterings from lithium were also studied. For the same momentum transfer on scattering, the ratio of the inelastic scattering with excitation to the 4.43 and 9.61-Mev levels to the elastic differential scattering cross section is the same, within experimental accuracy, as found by Fregeau for the scattering of 187-Mev electrons on carbon. The elastic scattering is compared with the results of complex square-well phase shift calculations, and with diffuse-edge optical model and modified Kisslinger model calculations. (auth)

8082

THEORETICAL CALCULATIONS OF THE SCATTERING OF π-MESONS BY COMPLEX NUCLEI. W. F. Baker, H. Byfield, and J. Rainwater (Columbia Univ., New York). Phys. Rev. 112, 1773-8(1958) Dec. 1.

The angular distributions of 80-Mev negative pions elastically scattered from Li, C, and Al were analyzed on the basis of optical models by using I.B.M.-

650 computers. It was not possible to fit the data with the usual $V_1 + iV_2$ type model having either a square or diffuse edge and V_1 and iV_2 proportional to the nuclear density. A Kisslinger-type model, which takes better account of the p-wave nature of the basic π-nucleon scattering process, was also used with a modification to avoid a physically unreasonable behavior of the effective interaction. Using $r_0 = 1.08$ and a diffuseness parameter $a = 0.25$ in a Saxon-type density distribution, good agreement with experimental data was obtained. (auth)

8083

EXPERIMENTAL RESULTS ON THE RADIATIVE π-μ DECAY. C. Castagnoli and M. Muchnik (Univ. of Rome). Phys. Rev. 112, 1779-84(1958) Dec. 1.

A total of 93,045 π-μ-e decays were examined in Ilford G-5 plates, where both the π- and the μ-meson decays take place in the emulsion, in order to study the $\pi \rightarrow \mu + \nu + \gamma$ decay. From the total number of short muon tracks thus found, all cases possibly due to pion decays in flight were eliminated. Accurate corrections were carried out taking into account the straggling effects on the normal muons, so as to establish a safe upper limit in the anomalous muon range determination. After carefully correcting for the geometrical losses and experimental biases, the value $(1.24 \pm 0.25) \times 10^{-4}$ was obtained for the probability of a pion decaying into a muon whose track is shorter than 435 μ. This result is in fair agreement with the theoretical predictions on the pion radiative decay. (auth)

8084

ACCELERATION OF COSMIC RADIATION. G. S. Murty and R. K. Varma (Tata Inst. of Fundamental Research, Bombay). Phys. Rev. 112, 1789-92(1958) Dec. 1.

Alfvén's model of discontinuous magnetic field variations for the acceleration of cosmic rays by the betatron mechanism was generalized to continuous field variations, with special reference to sinusoidal fields. It is shown that the efficiency of this model is maximum when the "rate of randomization" is equal to the frequency of oscillation of the magnetic field. Also the maximum efficiency is comparable with those of Alfvén's and Parker's models. (auth)

8085

EXAMPLE OF THE PRODUCTION OF A π^- MESON BY A K^+ MESON. E. Helmy, J. H. Mulvey, D. J. Prowse, and D. H. Stork (Univ. of California, Los Angeles). Phys. Rev. 112, 1793-5(1958) Dec. 1.

In 50 meters of 200 to 300 Mev K^+-meson track followed in nuclear emulsion, one interaction event was found from which a pion track emerges. The incoming K^+ meson had a kinetic energy of 323 ± 20 Mev. The K^+ meson re-emerged with an energy of 30 Mev at 36 degrees. The pion track has a characteristic π^- ending, and the pion was emitted with 34 Mev at 96 degrees. In addition a 40-Mev proton left the star at 81 degrees and there are three other short tracks. Although the kinematics admit an analysis in which no inelastic secondary process occurred among the primary reaction products, strong inelastic secondary processes are quite possible and must be considered. Charge independence holds important implications for the pion yield charge ratios and the early trend of negative excess seems rather striking. (auth)

8086

DECAY MODES OF A $(\theta + \bar{\theta})$ SYSTEM. M. Goldhaber, T. D. Lee, and C. N. Yang (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 112, 1796-8(1958) Dec. 1.

Relations among the different states of a system consisting of a θ meson, a $\bar{\theta}$ meson, and a certain number of pions are discussed. Theorems concerning certain correlations between the production probabilities for charged and uncharged θ mesons and the decay modes (θ_1^0 and θ_2^0) are obtained. (auth)

8087

UNUSUAL COSMIC-RAY INTENSITY FLUCTUATIONS OBSERVED AT SOUTHERN STATIONS DURING OCTOBER 21-24, 1957. K. G. McCraken and N. R. Parsons (Univ. of Tasmania, Hobart). Phys. Rev. 112, 1798-1801(1958) Dec. 1.

Observations are reported from four southern stations of cosmic-ray intensity fluctuations during the period October 21-24, 1957. These fluctuations exhibit unusual features which suggest the existence of a short-lived and highly directional anisotropy of the primary radiation during the period immediately preceding a Forbush-type decrease. (auth)

8088

DISCREPANCY BETWEEN π^--PROTON SCATTERING AND A DISPERSION EQUATION. Howard J. Schnitzer and George Salzman (Univ. of Rochester, N. Y.). Phys. Rev. 112, 1802-9(1958) Dec. 1.

The π^--proton scattering is reanalyzed following Puppi and Stanghellini. The use of more recent data in evaluating the very sensitive principal value integral and a more detailed error analysis lead, with the same coupling constant, $f^2 = 0.08$, and the same S-wave scattering lengths, $a_1 = 0.165$ and $a_3 = -0.105$, to much less disagreement than they found. However, a residual discrepancy of the same general character remains. It is pointed out that the analysis is very sensitive to the experimental charge exchange scattering, and two alternatives to using this data are suggested. The importance of D waves, in extending the analysis to energies above 300 Mev, is demonstrated. It is shown that contributions from energies above ~2 Bev, and reasonable changes in f^2, a_1 and a_3, cannot contribute significantly towards resolution of the discrepancy. (auth)

8089

PRODUCTION OF AUGER ELECTRONS BY NEGATIVE K MESONS AND π MESONS. Elizabeth B. Chesick and J. Schneps (Tufts Univ., Medford, Mass). Phys. Rev. 112, 1810-12(1958) Dec. 1.

The mesonic Auger effect was studied for K^- and π^- mesons. It is expected that the frequency of production of Auger electrons of energy greater than 15 kev should be about 50% greater for K mesons than for π mesons due to the greater mass of the K meson. 200 π-meson stars and 195 K-meson stars in nuclear emulsion were examined for associated slow electrons of energy greater than 15 kev. For π mesons it is found that 14% of the stars have one Auger electron and 4% have two. For K mesons 25% have one, 6% have two, and 1% have three. Thus 18% of all π-meson stars and 32% of all K-meson stars have one or more associated Auger electrons. Assuming that 54% of all stars are in the heavy elements of the emulsion, it is found that 33% of π mesons and 59% of K mesons captured in silver and bromine have one or more associated Auger electrons. Hence the increase in production by K mesons over that by π mesons is about 75%. (auth)

8090

ELECTROMAGNETIC EFFECTS IN MESON-NUCLEON SCATTERING. R. A. Sorensen (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev. 112, 1813-25(1958) Dec. 1.

The dominant part of pion-nucleon scattering is charge independent. In view of the apparent discrepancies in the dispersion relations for meson scattering, it is desirable to investigate the effects on meson-nucleon scattering of including the electromagnetic interaction in an otherwise charge-independent theory. The calculation, which is performed in the static-nucleon, one-meson approximation of Chew and Low, is divided into two parts. In the first part, the effects of the charged-neutral meson mass difference, which is assumed to be of electromagnetic origin, are calculated. In the second part, other electromagnetic effects involving one virtual photon are calculated in the "Coulomb approximation," in which the effects of transverse photons and of graphs in which the incoming and outgoing meson lines are crossed, are ignored. A formula is given by means of which the three meson-photon differential cross sections may be analyzed in terms of the six charge-independent s- and p-wave phase shifts which would occur in the absence of the electromagnetic interaction. Aside from simple Coulomb and kinematic effects, the most important effect in π^+-proton scattering can be expressed as an alteration of the $J = 3/2$ phase shift for that state such as to sharpen the (3,3) resonance and move it to a higher energy. The meson mass difference effect and the Coulomb effect contribute about equally to produce a phase shift alteration of about 2° at its largest. (auth)

8091

p-p S-WAVE PHASE SHIFTS FROM A BOUNDARY CONDITION POTENTIAL. Malcolm H. MacGregor (Univ. of California, Livermore). Phys. Rev. Letters 2, 106-7 (1959) Feb. 1.

Moszkowski and Scott have recently shown analytically that a two-nucleon potential featuring the boundary condition given by $[(1/u)\,(du/dr)]_{r=c} = (1/c)$ yields the same results as a hard core potential to within ½ degree for the singlet-S phase shift over the range 0 to 250 Mev. Calculations for the realistic case of a core followed by a Yukawa well are performed using conventional iteration techniques. (W.D.M.)

8092

HELICITY OF NEGATIVE MUONS FROM PION DECAY. W. A. Love, S. Marder, I. Nadelhaft, R. T. Siegel, and A. E. Taylor (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev. Letters 2, 107-10(1959) Feb. 1.

Preliminary results of an experiment for the direct measurement of the helicity of μ^- mesons from pion decay are reported. The experiment involves the detection of the asymmetry of β decay of B^{12} produced by polarized muons via the reaction $\mu^- + C^{12} \rightarrow B^{12} + \nu$. (W.D.M.)

8093

$\overline{K}^0$-K^- MASS EXCESS. Arthur H. Rosenfeld, Frank T. Solmitz, and Robert D. Tripp (Univ. of California, Berkeley). Phys. Rev. Letters 2, 110-12(1959) Feb. 1.

Using the charge exchange of $\overline{K}^-$ in a hydrogen bubble chamber, it was found that $\overline{K}^0$ is 3.7 ± 0.7 Mev heavier than K^-. The incident K^- ranged in energy from 10 to 150 Mev. A total of 44 charge-exchange events was observed. (W.D.M.)

8094

K^0–K^+ MASS EXCESS. Frank S. Crawford, Jr., Marcello Cresti, Myron L. Good, M. Lynn Stevenson, and Harold K. Ticho (Univ. of California, Berkeley). Phys. Rev. Letters 2, 112-13(1959) Feb. 1.

In a study of associated production by 1.12 Bev/c negative pions incident on a liquid hydrogen bubble chamber, a discrepancy was found between the K^0 and K^+ production and decay dynamics, if currently accepted values for the masses involved are used. The discrepancy is most easily resolved if the mass of the K^0 exceeds that of the K^+ by about 5 Mev. The experimental method is described. (W.D.M.)

8095

EXPERIMENTAL DETERMINATION OF THE Λ SPIN. Frank S. Crawford, Jr., Marcello Cresti, Myron L. Good, M. Lynn Stevenson, and Harold K. Ticho (Univ. of California, Berkeley). Phys. Rev. Letters 2, 114-16(1959) Feb. 1.

The method recently proposed by Lee and Yang for determining the spin of the Λ hyperon is applied to 614 decays of the type $\Lambda \rightarrow \pi^- + p$. The Λ's were produced in a 10-inch liquid hydrogen bubble chamber via the reaction $\pi^- + p \rightarrow K^0 + \Lambda$. The method makes possible an absolute determination of the Λ spin without assumptions other than that angular momentum is conserved in the decay. It is concluded that the Λ spin is ½. (W.D.M.)

8096

K-MESON-NUCLEON TOTAL CROSS SECTIONS FROM 0.6 TO 2.0 Bev. H. C. Burrowes, D. O. Caldwell, D. H. Frisch, D. A. Hill, D. M. Ritson, and R. A. Schluter. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Letters 2 117-19(1959) Feb. 1.

An experiment to measure the K–nucleon total cross sections at high energy using the K-meson beam of the Bevatron is described. The cross sections for $K^+ - N$, $K^+ - p$, and $K^- - p$ were measured. The lifetimes of K^+ and K^- were determined. The $K^+ - p$ and $K^+ - n$ cross sections are about the same in this energy range, but the $K^- - p$ cross section is twice as large. (W.D.M.)

8097

PION-PROTON RESONANCE SCATTERING NEAR 900 Mev. H. C. Burrowes, D. O. Caldwell, D. H. Frisch, D. A. Hill, D. M. Ritson, R. A. Schluter, and M. A. Wahlig (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Letters 2, 119-21(1959) Feb. 1.

The scattering of negative and positive pions by hydrogen in the laboratory energy range 470 to 1200 Mev was investigated in order to clarify the broad resonance occurring near 900 Mev. The target was five feet of liquid hydrogen. The experimental setup is described, and results are given. (W.D.M.)

8098

π^--p SCATTERING BELOW 1 Bev. R. R. Crittenden, J. H. Scandrett, W. D. Shephard, and W. D. Walker (Brookhaven National Lab., Upton, N. Y.) and J. Ballam (Michigan State Univ., East Lansing, and Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters 2, 121-4(1959) Feb. 1.

Measurements of π^--p total and differential elastic cross sections in the energy range 400 to 800 Mev were carried out. This work was done by exposing a propane bubble chamber in a pion beam at the Brookhaven Cos-

motron. Results are shown for a total of 60,000 pictures. (W.D.M.)

8099
THE STUDY OF PHOTONS BY MEANS OF THE THIRD SOVIET ARTIFICIAL EARTH SATELLITE. A. E. Chudakov. Priroda 47, No. 12, 88-90(1958) Dec. (In Russian)

Descriptions are given on the luminescence counter erected in the third man-made satellite, and data are presented on photon studies made with the aid of the instrument. It was found that the electron bombardment count exceeded 10 times or more the anticipated rate from cosmic rays. Preliminary data on photon counter recordings are shown graphically. (R.V.J.)

8100
π-MESON PAIR PRODUCTION BY γ-QUANTA ON NUCLEONS IN A STRONG COUPLING THEORY. Y. V. Tsekhmistrenko (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Ukrain. Fiz. Zhur. 3, 35-40(1958) Jan.-Feb. (In Russian)

The photoproduction of π-meson pairs is considered in a strong coupling approximation. For simplification the effect is examined at the threshold. The calculations are carried out in the second approximation of the perturbation theory. The cross sections obtained are in good agreement with published data. (R.V.J.)

8101
PROTON DISTRIBUTION IN NONSPHERICAL NUCLEI. Yu. V. Tsekhmistrenko. Ukrain. Fiz. Zhur. 3, 139-40 (1958) Jan.-Feb. (In Russian)

Previous work on nonspherical nuclei was based on the approximation of uniform distribution of nuclear charge. However, distortions in nuclear shape induce distortions in spherico-symmetric distributions of nucleons. Studies of small deformations are limited to quadrupole additions to the spherico-symmetric density of protons (the changes in neutron distributions are not considered). (R.V.J.)

8102
MAGNETIC AND COSMIC RAY STORMS. B. Trumpy. Univ. i Bergen Arbok Naturvitenskap. Rekke No. 2, 28p. (1959).

Detailed studies on individual cosmic ray storms in different components of the cosmic radiation were carried out for the Norwegian stations at Tromsø and Bergen and for foreign stations in Germany, Japan, and Tasmania. For each component individual cases were investigated regarding the increasing phase displacement with increasing storm time between the amplitudes of the magnetic- and cosmic-ray storms. Further the amplitude of individual cosmic-ray storms were measured for the neutrons, the soft component, the total radiation, and for different hard components. In this way valuable information is obtained regarding the dependence of the amplitude of a cosmic ray storm on the mean energy of the primaries which produced the cosmic-ray component in question. Also the dependence of cosmic ray storms on the geomagnetic latitude was investigated for different radiation components. The diurnal variation of cosmic ray storms was studied in a series of cases for different components and for mesons incident from different directions. Special cases of increases of the cosmic ray intensity and their dependence on the geomagnetic latitude were reported for a period of intense solar flare activity, September 18th to 23rd 1957. Different possibilities for a theoretical description of the cosmic ray storm phenomenae and their connection with solar activity and magnetic storms are discussed. (auth)

Heat Transfer and Fluid Flow

8103 CF-58-2-124
Oak Ridge National Lab., Tenn.
PROPOSAL FOR AN EXPERIMENTAL STUDY OF THERMAL GRADIENT MASS TRANSFER IN A THERMAL CONVECTION LOOP. J. W. Prados and J. L. Scott. Feb. 18, 1958. 10p. Contract [W-7405-eng-26]. $1.80(ph), $1.80(mf) OTS.

A proposal is presented to design, construct, and operate a thermal gradient mass transfer loop to provide data on rates of solution and deposition as functions of time. Operation of the hot solution zone under controlled isothermal conditions is planned. It is felt that data obtained in such a loop would be of value in assessing the validity of presently proposed mechanisms for thermal gradient transfer or in devising new ones. The thermal and forced convection loops appear to offer most promise of yielding significant results. Descriptions of the proposed metal systems to be studied are given along with the experimental procedure and method of data analysis. (J.R.D.)

8104 KAPL-M-EWG-1
Knolls Atomic Power Lab., Schenectady, N. Y.
FUNDAMENTAL INVESTIGATION OF BOILING HEAT TRANSFER AND TWO-PHASE FLOW. Edward W. Grohse, Gerhard O. Mueller, and John A. Findlay. Oct. 17, 1958. 128p. Contract W-31-109-Eng-52. $21.30(ph), $6.90(mf) OTS.

Significantly improved theories of two-phase heat transfer and prediction of departure from nucleate boiling have recently been developed which for the first time are not based on empirical relationships. These theories should be critically analyzed in relation to naval reactor work and tested with all existing data from both classified and unclassified sources. Conflicting analyses of two-phase fluid flow regimes confuse this area, and essentially no data or theories are available for two-phase flow with superimposed boiling. Theories and understanding of two-phase flow with boiling should be developed, starting from proven theories without boiling, and tested against all existing data or new data as necessary. A substantial start has been made in analysis of the case of upward annular two-phase flow in vertical channels, based upon modern knowledge of boundary layer and vapor condensation principles. (auth)

8105 LA-1914(Del.)
Los Alamos Scientific Lab., N. Mex.
TAYLOR INSTABILITY IN SHOCK ACCELERATION OF COMPRESSIBLE FLUIDS. Robert D. Richtmyer. July 1954. Decl. with deletions Feb. 10, 1959. 43p. Contract W-7405-eng-36. $7.80(ph), $3.30(mf) OTS.

The initial growth of irregularities on an interface between two compressible fluids is studied for impulsive (i.e., shock) acceleration. It was found that the ultimate rate of growth is roughly the same as that given by the incompressible theory, if the initial compression of the irregularities and of the fluids is taken into account. (auth)

8106 NP-7228
California. Univ., Berkeley. Sanitary Engineering Research Lab.
STUDIES OF FLOW DISPERSION IN POROUS MEDIA; CANAL SEEPAGE RESEARCH. Progress Report No. 4

Covering Period July 1, 1957 to June 30, 1958. Leung-Ku Lau, Warren J. Kaufman, Gerald T. Orlob, and David K. Todd. July 1, 1958. 71p. Contract 14-06-200-4072.

The medium dispersion constant is a measure of the degree of longitudinal dispersion of a tracer in water moving at a constant velocity through a water-saturated, homogeneous, porous medium. This constant is known to be a function of the porous medium only. A laboratory study was made to relate this constant to the pore-size distribution, which was approximated from the moisture-tension curve of the medium. The porous media used were five sand fractions sieved from a Hanford sand having an over-all range of grain size from 0.175 to 0.833 mm. Each of these sands was tightly and similarly packed into identical columns; porosity, permeability, longitudinal dispersion, and moisture-tension curves were determined for each. Experimental results showed that all the pore-size distributions were skewed. Various parameters were obtained both from the pore-size distributions and from the porosities and permeabilities, but were found to have no well defined relationship with the medium dispersion constant. The lack of relationship may be due to the pore shape and anisotropy of the porous medium which may be the controlling factors of the medium dispersion constant. Investigations of the dispersion of a water tracer in a radial flow-pattern were continued with a laboratory study. An experimental model was constructed consisting of a 45-degree circular sector having a 36-inch radius and a 3-inch depth. An injection well is situated at the apex and sampling points are located along four radii. The model and apparatus were set up for tests. Experimental data and analyses will be presented in the next report. Abstracts for reports number 2 and 3 are included. (auth)

8107 NP-7240

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

THE APPLICATION OF MAGNETIC NUCLEAR RESONANCE IN HYDRODYNAMICS. Report No. 56/II. A. Z. Hrynkiewicz. Dec. 1958. 11p.

The recording of the nuclear resonance line by means of a mirror oscillograph has made it possible to employ the phenomenon of nonadiabatic transition in a stream of flowing fluid for studying the character of the flow. Nonadiabatic transition was used to mark the flowing fluid in a given section of a pipe in a time of the order of a microsecond. The nuclear resonance apparatus served as the detector of the marked fluid after it had traversed a certain distance in the pipe. In order to illustrate the method, the shape of pulses in the detector was studied for laminar flow and for turbulent flow in a smooth cylindrical pipe. (auth)

8108 NP-7249

Convair Scientific Research Lab., San Diego, Calif.

BIBLIOGRAPHY ON BOUNDARY LAYERS AND RELATED SUBJECTS. Hans U. Eckert. Mar. 6, 1957. 133p.

The collection of unclassified papers and reports listed was started several years ago in order to have on hand information from the various fields of boundary layer research, primarily the newer publications. Although the list presently comprises nearly 800 references, it represents only a fraction of the work actually published in the last decade. This applies especially to the fields of boundary layer control and heat transfer where the collection has been pursued in a more random fashion. A systematic effort to obtain what is available from the literature has been made for the limited sector of turbulent boundary layers in supersonic flow. The main source of information is the Journal of the Aeronautical Sciences from which papers and notes contained in volumes 16-23 (1949-1956) are listed. The second source are NACA notes, reports, and memoranda. In the third place articles from various periodicals and reports from research institutes, domestic and foreign, have been used. (auth)

8109 NP-7285

Lehigh Univ., Bethlehem, Penna. Inst. of Research.

MEASUREMENT OF WALL HEAT TRANSFER AND OF TRANSITION TO TURBULENCE DURING HOT GAS AND RAREFACTION FLOWS IN A SHOCK TUBE (thesis). Technical Report No. 12. Albert J. Chabai. Sept. 1, 1958. 93p. Project NR 061-063. Contract N7-onr-39302.

A thin film resistance thermometer was developed for the study of transient boundary layer flows in the shock tube. The response time is less than 1 μsec. With this instrument wall temperatures are measured, gas-to-wall heat transfer rates may be determined, and transitions to turbulent flow detected. Measurements of wall heat flux during laminar flow are presented and compared with theories for the hot gas, the cold gas, and the rarefaction regions of shock tube flows. The experimental results indicate an excellent agreement with the theories of hot gas flow, a general consistency with the theory of cold gas flow, but some unaccountable deviations from the theoretical expectations for rarefaction flows. Measurements of the time at which transition from laminar to turbulent flow occurs are also presented for a number of hot gas and rarefaction flows. A Reynolds number for the hot gas flow is proposed whose critical value predicts the time at which the laminar flow is observed to become turbulent. Several Reynolds numbers for the rarefaction flow are proposed, but no correlation between these Reynolds numbers and the measured transition times is found to exist. The instrument described allows previously unexplored boundary layer phenomena to be investigated. (auth)

8110 WT-1527

Broadview Research Corp., Burlingame, Calif. and California. Univ., Mercury, Nev. Radiation Lab.

TEMPERATURES FROM UNDERGROUND DETONATION, SHOT RAINIER. T. C. Goodale, B. Ragent, A. H. Samuel, A. L. Anderson, D. E. Nielsen, and J. L. Olsen. July 1958. 51p. Project 26.3 [of] OPERATION PLUMBBOB. $1.50(OTS).

The results of temperature measuring experiments conducted for Rainier shot, Operation Plumbbob are described. The temperature distribution in the surrounding tuff resulting from the detonation of an underground nuclear device yielding 1.7 kilotons of energy has been measured. Data indicate peak temperatures in the vicinity of 90°C existing in the central regions which drop rapidly to approach ambient temperatures at distances of about 180 feet from the original ground zero. Based on measurements taken in three holes drilled into the central regions, contours of constant temperature are constructed. The temperature picture is consistent with the consideration that most of the heat entered the water contained originally in the tuff and the unconsolidated material which filled the cavity after its initial collapse. The amount of energy contained in the central regions in

the form of tuff heated to below 90°C is roughly estimated to be greater than one-half of the total energy release. An unsuccessful attempt to measure the temperature rise across the shock front of the pressure wave produced by the detonation is described, and reasons for failure are discussed. (auth)

Nuclear Properties and Reactions

8111 A/CONF.15/P/1636

ON THE SPECTRUM OF NEUTRONS EMERGING FROM MODERATORS. R. Ramanna, N. Sarma, C. S. Somanathan, K. Usha, and G. Venkataraman (Atomic Energy Establishment, Trombay, India). 14p.

A slow chopper neutron velocity spectrometer was used to measure the energy spectrum of thermal neutrons emerging from various moderators like beryllium oxide and heavy water. The moderator assembly was placed in front of the core of the swimming pool reactor, Apsara, at the position of the shielding corner to obtain the necessary intensities. The temperatures of the Maxwellian distributions under various conditions were determined as well as the distortions of the Maxwellian spectrum due to the variations with energy of the transport mean free path of these moderators. From these the variation of λ with energy was estimated. (auth)

8112 AFOSR-TN-59-15

California. Univ., Santa Barbara.

NUCLEAR ABSORPTION CROSS SECTIONS FOR 3.6 BEV NEUTRONS. Paul H. Barrett. Dec. 22, 1958. 7p. Contract AF49(638)-9. (AD-208596).

The absorption cross section for Pb, Cu, and Al were measured by means of poor geometry transmission measurements. The neutrons were produced by bombarding a 1-in. thick polyethylene target with 6.2-Bev protons in the Bevatron. Neutron detection was accomplished by measuring the density of stars in nuclear emulsion. These measurements gave for the absorption cross sections for Pb, Cu, and Al: 1930 ± 300, 704 ± 140, and 430 ± 56 mb. An absorption mean free path in emulsion of $\lambda = 50 \pm 10$ cm was obtained. The source strength of the neutrons was calculated to be 0.19 neutron/steradian/proton striking the target. By comparing the multiplicity of mesons produced in nuclear interactions by the neutron beam and by protons of known energy the average energy of 3.6 ± 0.7 Bev was obtained for the neutron beam. (auth)

8113 UCRL-5420

California. Univ., Livermore. Lawrence Radiation Lab.

THE STATUS OF EXPERIMENTAL NEUTRON CROSS SECTIONS FOR ENERGIES BETWEEN 0.5 AND 14.5 MEV. Robert J. Howerton. Dec. 1958. 26p. Contract W-7405-eng-48. $0.75 (OTS).

The present state of knowledge of the total, elastic scattering, inelastic scattering, and (n,2n) cross sections from 0.5 to 14.5 Mev is presented, and it is such that at least nine years of measurement at the rate of the most productive year to date would be required to eliminate, by experiment, the ignorance of these values. It is estimated that with good fortune in developing systematics and mathematical models all the problems of neutron cross sections in this energy range may be solved in twenty years if an effort is concentrated equal to that expended in the most productive year to date. (auth)

8114 UCRL-8553

California. Univ., Berkeley. Lawrence Radiation Lab.

ATOMIC BEAM RESEARCH ON RADIOACTIVE ATOMS. (The First Ernest O. Lawrence Memorial Lecture, Meeting of the National Academy of Sciences, Berkeley, California). W. A. Nierenberg. Nov. 7, 1958. 46p. Contract W-7405-eng-48. $1.25(OTS).

The study of nuclear structure by the combined use of atomic beams and particle detection techniques is discussed, and some results obtained at the Atomic Beam Laboratory of the University of California are given to illustrate. Data are given on: spin of Ag^{110m}; production of Rb isotopes by Br(α,kn) reaction versus α energy; decay of Rb^{81}, Rb^{82}, Cs^{129}, Cs^{131}, and Cs^{132}; energy levels of Br^{82} and Br^{76}; spin of Ga^{66} and Ga^{77}; spins of isotopes of K, Cu, Ga, Br, Rb, Ag, In, I, Cs, Au, Tl, Bi, At, Pa, Np, Pu, Am, and Cu; Tl^{204} resonances versus magnetic field; energy levels in Np^{238}; heavy element ground states; and electronic coupling in Cu. (T.R.H.)

8115

ENERGY SPECTRA OF α PARTICLES FROM THE REACTION $C^{12}(d,\alpha)B^{10}$. I. EXCITED STATES OF B^{10}. J. Catalá, A. Bonet, and E. Villar (Instituto de Optica "Daza de Valdes," Valencia). Anales real soc. españ. fis. y quim. (Madrid) Ser. A 54, 247-54(1958) Sept.-Oct. (In Spanish)

In studies on nuclear reactions produced when acetylene gas is bombarded by 19.17-Mev deuterons, using the photographic method, α tracks from the $C^{12}(d,\alpha)B^{10}$ reaction were found. Fourteen plates were studied at 17 different angles and α groups corresponding to the ground state and to the following B^{10} excited levels: 0.71, 2.14, 3.59, 4.73, 5.17, 5.65, and 6.15 Mev. The absence of the 1.74-Mev level is consistent with the isotopic spin selection rules since it is known to be T = 1. (auth)

8116

NUCLEAR SPECTROSCOPY OF THE NUCLIDES OF THE THORIUM FAMILY BY THE DISCRIMINATE COINCIDENCE METHOD. Francesca Demichelis and Benito Chinaglia. Atti acad. nazl. Lincei Rend. Classe sci. fis. mat. e nat. 22, 613-15(1957) May. (In Italian)

The gamma spectra of Th^{228} in equilibrium with its decay products were studied. The results confirmed the existence of the 0.084–0.137 Mev and the 0.084–0.170 Mev γ-γ cascades for Th^{228}. A new 0.254-Mev gamma ray was found in the decay of Ra^{224}. The decay scheme proposed for Pb^{212} was verified. A 0.284–0.281 Mev γ-γ cascade was found in Bi^{212} and possibly a 0.162–0.281 cascade. The decay scheme of Tl^{208} was amplified. (J.S.R.)

8117

SOLID AND LIQUID STATE RESEARCH WITH COLD NEUTRONS. P. A. Egelstaff (United Kingdom Atomic Energy Authority). Brit. J. Appl. Phys. 10, 1-9(1959) Jan.

The basic physical information which can be obtained from studies of the scattering of cold neutrons by matter is reviewed. The theoretical background is covered in a general way only, but the properties of the energy transfer processes and the information they yield concerning the thermal behavior of matter are emphasized. Experimental work is discussed historically where appropriate, and numerous recent experiments are mentioned (without considering any one in detail) to illustrate the many branches of these fields into which cold neutron research is moving. With the current

improvements in experimental neutron fluxes and techniques, cold neutron methods will be used extensively during the next decade for solid and liquid state research. (auth)

8118

POLONIUM-210 AS A STANDARD FOR γ RADIATION. Geneviève Bastin-Schoffier and Robert J. Walen. Compt. rend. 247, 2333-5(1958) Dec. 22. (In French)

The α magnetic structure of polonium-210 was studied to determine the branching ratio in the fine structure. The ratio of the weak alpha to the strong alpha emission was determined, and the γ/α ratio was found to be 1.006×10^{-5}. (J.S.R.)

8119

DYNAMIC POLARIZATION OF THE NUCLEOUS OF SILICON-29 IN SILICON AT 4.2°K. Anatole Abragam, Jean Combrisson, and Ionel Solomon. Compt. rend. 247, 2337-40(1958) Dec. 22. (In French)

The dynamic polarization of the Si^{29} nucleus in silicon was studied at the temperature of liquid helium. The "solid effect" obtained, distinct from the Overhauser effect, was described. (tr-auth)

8120

CALCULATION OF THE CROSS SECTIONS OF PHOTONUCLEAR REACTIONS CAUSED BY BREMSSTRAHLUNG RADIATION. Robert Basile, Mark Gusakow, and Jean-Marie Lagrange. Compt. rend. 248, 89-92(1959) Jan. 5. (In French)

A method for calculating the effective cross sections of photonuclear reactions in a zone from 2 to 12 Mev above the reaction threshold is proposed. It generalizes the Boulègue method (Compt. rend. 244, 881(1957)) and is more precise than the Penfold and Leiss method (Analysis of Photo Cross Sections, Publication of the Physics Research Lab., Univ. of Illinois, Champaign, Ill., 1958). (tr-auth)

8121

THE FORMATION OF ASTATINE-210 AND 211 BY SPALLATION OF THORIUM-232 BY 160-Mev PROTONS. Marc Lefort, Gabriel Simonoff, and Xavier Tarrago. Compt. rend. 248, 216-18(1959) Jan. 12. (In French)

During the course of investigations with the Orsay synchrocyclotron on the spallation reactions of Th^{232} by 160-Mev protons, the isotopes of At^{210} and At^{211} were detected by chemical separation and analysis of the alpha spectra. The effective cross section for their formation was calculated. (tr-auth)

8122

ANGULAR DISTRIBUTIONS AND CORRELATIONS IN THE REACTION $B^{10}(d,p)B^{11}$. Serge Gorodetzky, Michel Croissiaux, André Gallmann, Pierre Fintz, Jacques Samuel, and Georges Frick. Compt. rend. 248, 550-3 (1959) Jan. 26. (In French)

The angular distributions of protons relative to the 4.46 and 5.03 Mev levels of B^{11} were studied in the $B^{10}(d,p)B^{11}$ reaction, and some p-γ angular correlations for these two levels were determined. The results are graphed and indicate that the "stripping" contribution is more important for the 4.46-Mev level than for the 5.03-Mev level in the angular distribution. The correlations for the 4.46-Mev level may be considered as isotropic, but the correlations for the 5.03-Mev level are anisotropic. (J.S.R.)

8123

ON THE FORMATION OF THE SUPERFLUID STATE IN THE ATOMIC NUCLEUS. V. G. Solovev (Joint Inst. of Nuclear Research). Doklady Akad. Nauk S.S.S.R. 123, 652-4(1958) Dec. 1. (In Russian)

The mathematical methods and the variation principle (the generalized Fock Method) suggested by N. N. Bogolyubov et al. (New Methods in the Theory of Superconductivity, Pub. of the Acad. of Sciences U.S.S.R., 1958) were used in studies of the superfluid state in the atomic nucleus. The results confirm the previous assumption that the formation of the superfluid state can be used for clarification of the energy cut-off between the basic and primary single excitation states in heavy, even-even nuclei. However, in odd nuclei the energy cut-off is absent, and during excitation, transitions inside the external shell are observed. (R.V.J.)

8124

POLARIZATION OF METALLIC LITHIUM NUCLEI. N. A. Bekeshko and E. I. Kondorskii. Fiz. Metal i Metalloved. 6, 609-13(1958). (In Russian)

An analysis was made of the Overhauser effect and polarization of nuclei. The amplitudes of nuclear magnetic resonance (which are in direct proportion to the degree of nuclear polarization) were studied in weak magnetic fields. The gyromagnetic ratio for Li^7 nuclei was 1.040×10^4 gauss/sec. In order to determine the dependence of nuclear polarization on the saturation of resonance related to the conducting electrons, measurements were made of the signal amplitudes in the generator high-frequency magnetic field at various intensities. The width of the nuclear resonance at 57°C was 0.08 gauss. (R.V.J.)

8125

COMPRESSION AND THE α-β PHASE TRANSITION OF PLUTONIUM. P. W. Bridgman (Harvard Univ., Cambridge, Mass.). J. Appl. Phys. 30, 214-17(1959) Feb.

Recent lifting of the security restrictions now permits publication of measurements of various effects of pressure on plutonium made during the war. Compressions on the alpha phase were measured at room temperature to 40,000 kg/cm^2 in one apparatus and to 100,000 in another. The total volume compression under 100,000 is very close to 10%. Compressibility decreases with increasing pressure as is normal. Exploration for other transitions was made to 20,000 kg/cm^2 at 100° and 200°—none were found. The pressure and the volume change of the alpha-beta transition was measured at 162.6° and 205°. The transition curve is "normal," the pressure rising with increasing temperature with downward curvature, and volume increment decreasing. The volume increment averages nearly 9%. The pressure of transition at 205° is very approximately 7000 kg/cm^2. The calculated latent heat of transition at the mean pressure is roughly 4.5 cal/g. (auth)

8126

ZEROSPLITTING CONE OF NUCLEAR QUADRUPOLE RESONANCE SPECTRUM FOR SPIN $5/2$. Kenji Shimomura and Noriyoshi Inoue (Hiroshima Univ.). J. Phys. Soc. Japan 14, 86-90(1959) Jan.

Zero splitting loci of the nuclear quadrupole resonance spectrum of the iodine nucleus of iodic acid were studied. The directions of axes of zero splitting cones of $\nu_1(\pm 1/2 \rightarrow \pm 3/2)$ and $\nu_2(\pm 3/2 \rightarrow \pm 5/2)$ lines have been found to be appreciably different from each other. The situation was interpreted by use of Cohen's theory of Zeeman splitting, and the zero splitting condition was presented. The directions of axes of zero splitting

cones of ν_1 and ν_2 lines were shown to be coincident with the y and z axes of the principal axes of the field gradient tensor at the resonant nucleus, respectively. Cohen's theory was verified by the comparison of the experimental values of zero splitting angles with the theoretical ones. (auth)

8127

GAMMA-RAYS FROM INELASTIC NEUTRON SCATTERING IN Na^{23}. Joan M. Freeman and J. H. Montague (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Phys. 9, 181-97(1958) Dec. (1).

Gamma rays following inelastic neutron scattering in Na^{23} were measured with neutron bombarding energies up to 3.7 Mev, and the modes of decay of the first six excited states were investigated. Transitions to the ground state and to the first excited state at 0.44 Mev were observed with a ring geometry arrangement, and the cascade transitions were confirmed by γ-γ coincidence measurements. Where possible, estimates were made of the ratio of the intensities of emission from a particular level to the ground state and to the first excited state. The following gamma-rays were observed (an asterisk indicates a transition to the first excited state): 0.438 Mev from the first excited state; 2.088 and 1.643* Mev from the second excited state (intensity ratio 0.19); 2.386 and 1.954* Mev from the third excited state (intensity ratio 3.0); 2.635 Mev from the fourth and 2.27* Mev from the fifth excited state; 2.979 and 2.56* Mev from the sixth excited state (intensity ratio of the order unity). Cross section curves for excitation of the levels at 0.44, 2.08, and 2.39 Mev were also measured. (auth)

8128

NEUTRON RESONANCE PARAMETERS OF TANTALUM FROM 20 TO 100 eV. F. W. K. Firk (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Phys. 9, 198-204(1958) Dec. (1).

Values of the peak total cross section (σ_0) and the total width (Γ) for thirteen resonances in Ta between 20 and 100 ev were determined using the Harwell 15-Mev linear accelerator and time-of-flight spectrometer. The radiation widths (Γ_γ) were obtained assuming the spin weighting factor $g = \frac{1}{2}$. Refinements in the methods of analysis of transmission data enabled the parameters to be determined. These methods include a general "area" analysis which includes the effect of interference between resonance and potential scattering. (auth)

8129

RADIATION WIDTHS OF NEUTRON RESONANCES IN Ta. J. E. Evans, B. B. Kinsey, J. R. Waters, and G. H. Williams (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Phys. 9, 205-17(1958) Dec. (1).

The radiation widths of 12 neutron resonances in Ta were determined from a combination of transmission, resonanoe scattering, and capture measurements. The spins of the compound states corresponding to two of these resonances were found; both were of spin 4. In addition an unresolved pair near 35 ev, are probably both spin 4. The radiation widths of those with spin 4 were close to a mean value of 63 Mev. (auth)

8130

TIME DEPENDENT THEORY OF SCATTERING OF NUCLEONS BY NUCLEI. F. Coester and H. Kummel (State Univ. of Iowa, Iowa City). Nuclear Phys. 9, 225-36(1958) Dec. (1).

The optical model for the scattering of nucleons by nuclei is derived from the general time dependent scattering theory. The exclusion principle is taken into account without approximations. A suitably defined single particle wave function is shown to satisfy a "Schrödinger equation" with a non-hermitian "optical potential" defined by an integral equation in terms of the two body interaction. Solutions of this integral equation are not discussed. Thus the derivation of the model as such is separated from the approximations needed for its application to concrete problems. If the exclusion principle is taken into account the wave functions of the optical model are probability amplitudes only asymptotically for $t \to \pm\infty$. This asymptotic property is sufficient for the calculation of S-matrix elements and cross sections. (auth)

8131

ELECTRIC POLARIZABILITY OF ATOMIC NUCLEI. A. M. Baldin (P. N. Lebedev Physical Inst., USSR Academy of Sciences, Moscow). Nuclear Phys. 9, 237-41 (1958) Dec. (1).

A quantitative estimate is given of the effects depending on the existence of a tensor (spin-dependent) part in the electric polarizability of nuclei. (auth)

8132

PROTON DISTRIBUTIONS FROM $S^{32}(n,p)P^{32}$. H. P. Eubank, R. A. Peck, Jr., and F. L. Hassler (Brown Univ., Providence). Nuclear Phys. 9, 273-86(1958) Dec. (1).

Energy spectra of protons from natural sulfur bombarded with 14-Mev neutrons are shown at 0°, 30°, 60°, and 90°, obtained with a CsI scintillation spectrometer in coincidence with two particle-defining proportional counters. The observed characteristics are those of direct interaction, and the total energy spectrum is well fitted by the level density formula of Newton. The energy discrimination interval being broad but fairly sharp at its extremes, energy groups are not resolved but angular distributions for successive spectral intervals show marked changes at certain energies. From these abrupt changes and the known resolution characteristics the strongest contributing levels in P^{32} are located and assigned l values. The levels so deduced match the strongest contributors to (d, p) and (n, γ) processes leading to P^{32} and fit quantitatively the expected pattern of single particle transitions. Evidence is found of participation of protons from two initial states as expected, so that three final neutron levels account for five distribution components. All single particle excitations appear in the sequence expected except $2p_{\frac{1}{2}}$ (neutron), which seems to occur before $1f_{\frac{7}{2}}$. Integration of the spectra gives a mean "nuclear temperature" of 2.1 Mev and a cross section of 185 ± 30 mb for the first 9.5 Mev of residual excitation. (auth)

8133

BRANCHING RATIOS OF ELECTRON CAPTURE TO POSITON EMISSION. J. Konijn, B. Van Nooijen, H. L. Hagedoorn, and A. H. Wapstra (Technische Hogeschool, Delft, Netherlands). Nuclear Phys. 9, 296-305(1958) Dec. (1).

Ratios of electron capture to positon emission were measured by coincidence measurements with proportional counters, scintillation spectrometers and a beta ray spectrometer. Results for allowed transitions (Na^{22}, Sc^{44}, V^{48}, Mn^{52}, Co^{58}, and Ni^{57}) agree well with theoretical values as derived from Zweifel's work, and indicate a value of $-(0.007 \pm 0.010)$ for the Fierz term parameter. Results for $2^- \to 2^+$ first forbidden transi-

tions are about 20 to 60% higher than values derived from Zweifel's tables for allowed transitions. (auth)

8134

K⁻-ABSORPTION IN NUCLEI, AN ISOBARIC SPIN AND ANGULAR MOMENTUM ANALYSIS. P. K. Roy (Imperial Coll., London). Nuclear Phys. 9, 314-25(1958) Dec. (1).

The consequences of the conservation of isobaric spin in K^--meson capture on a pair of nucleons are investigated. Certain relations involving production cross-sections and capture and production ratios are derived; the effect of the assumption of the predominance of the final baryonic or meson-nucleon interaction is determined. Similar considerations are applied to the absorption processes in light nuclei like the deuteron and helium, etc. Lastly, an angular momentum analysis of the absorption processes is considered to determine the relative parities of the K and Y particles. (auth)

8135

ACTIVATION CROSS-SECTIONS FOR REACTIONS OF CHLORINE AND COPPER WITH 14.8 MeV NEUTRONS. R. S. Scalan and R. W. Fink (Univ. of Arkansas, Fayetteville). Nuclear Phys. 9, 334-6(1958) Dec. (1).

Absolute neutron activation cross-sections at 14.8 Mev were measured for chlorine and for the $Cu^{65}(n, p)$ reaction, based on comparison with $Cu^{63}(n, 2n)Cu^{62}$ reaction (556 mb) which was used as a standard monitor for the neutron flux. The observed reactions, half-lives, and cross-sections are: $Cl^{37}(n, p)S^{37}$, 5.0 min, 25.4 ± 2.1 mb; $Cl^{37}(n, \alpha)P^{34}$, 12.5 sec, 43.8 ± 6.9 mb; $Cl^{35}(n, \alpha)P^{32}$, 14.5 d, 122 ± 56 mb; $Cl^{35}(n, 2n)Cl^{34m}$ (upper state). 32.4 min, 5.6 ± 2.0 mb; $Cl^{35}(n. 2n)Cl^{34g}$ (ground-state), 1.5 sec, 2.8 ± 0.5 mb; and, from the copper monitor, $Cu^{65}(n, p)Ni^{65}$, 2.56 h, 31 ± 13 mb. Comparisons of the chlorine cross-sections with values estimated according to the compound nucleus theory as outlined by Blatt and Weisskopf show the usual deviations. These deviations are attributed to inadequacies in the simple version of the compound nucleus theory. (auth)

8136

AGE-DEPENDENT BRANCHING STOCHASTIC PROCESSES IN CASCADE THEORY. II. W. Max Woods and A. T. Bharucha-Reid (Univ. of Oregon, Eugene). Nuovo cimento (10) 10, 569-78(1958) Nov. 16.

A simple model of an electron-photon cascade in which the transformation probabilities are functions of absorber depth is considered. The mean and variance of the number of electrons in the cascade as a function of absorber depth are obtained and their properties discussed. An equation which yields the probability that the cascade will eventually terminate is also given. (auth)

8137

THE (γ, n) REACTION IN ^{4}He NUCLEI. D. L. Livesey (Univ. of British Columbia, Vancouver) and I. G. Main (Queen's Coll., Dundee, Scotland). Nuovo cimento (10) 10, 590-6(1958) Nov. 16.

The photographic plate method was used to detect He^3 particles emitted from helium gas exposed to bremsstrahlung of maximum energy 70 Mev. The $He^4(\gamma,n)He^3$ cross section is found to vary between values of (0.63 ± 0.10) mb at 40 Mev and (0.25 ± 0.04) mb at 60 Mev, the integrated cross section being 7.5 Mev mb between these limits. The angular distribution of the He^3 particles in the C.M. system has a peak in the forward direction and may be described by the expression $f(\theta) = B \sin^2\theta(1 + C \cos \theta)$ with C approximately equal to 0.5. (auth)

8138

NEUTRON SCATTERING AT 2.2 Mev BY TIME OF FLIGHT. H. H. Landon, A. J. Elwyn, et al. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 112, 1192-1200(1958) Nov. 15.

A millimicrosecond time-of-flight technique was applied to a study of the scattering of 2.2-Mev neutrons from targets of Fe, Pb^{206}, and Y. The 3-Mev phase-focused proton beam from the BNL 18-inch cyclotron was used to produce high-intensity neutron pulses in the $T(p,n)He^3$ reaction. The angular distributions of the elastically scattered neutrons have been measured for the above targets. The angular distributions of the inelastically scattered neutrons from the 0.845-Mev level in Fe^{56} and from the 0.803-Mev level in Pb^{206} were carefully studied and found to be symmetric about $\theta_{c.m.} = 90°$. The angular distributions of the inelastically scattered neutrons from levels at 1.34 and 1.43 Mev in Pb^{206} and from levels at 0.913 and 1.53 Mev in Y were measured and also appear to be symmetric about $\theta_{c.m.} = 90°$ The inelastic scattering from Pb^{206} shows evidence for a new level at 1.15 Mev. (auth)

8139

STUDY OF SOME (p,n) REACTIONS BY NEUTRON TIME OF FLIGHT. A. J. Elwyn, H. H. Landon, et al. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 112, 1200-9(1958) Nov. 15.

A millimicrosecond time-of-flight technique was applied to the study of (p,n) reactions in K, Ca^{48}, Ti, Cr, Mn, Fe, Cu, As, and Rb using the phase-focused 3-Mev proton beam from a small fixed-frequency cyclotron. The neutron spectra, resulting from these reactions, gave data from which the ground-state Q values and some of the energy levels in the residual nuclei have been determined. The reactions in K and Fe yielded only one neutron group each, which corresponded to the ground states in Ca^{41} and Co^{57}, respectively. In addition to the ground state Q values, the energies were determined for one excited state in each of the nuclei Mn^{53}, Mn^{54}, and Sr^{85}, two excited states in Zn^{65}, three excited states in Sr^{87}, and four excited states in each of the nuclei Sc^{48}, V^{49}, Fe^{55}, and Se^{75}. The angular distributions of the neutron groups were observed to be essentially isotropic in the $Ca^{48}(p,n)Sc^{48}$ and $Cu^{65}(p,n)Zn^{65}$ reactions. (auth)

8140

$N^{14}(\alpha,\alpha)N^{14}$ AND $N^{14}(\alpha,p)O^{17}$ DIFFERENTIAL CROSS SECTIONS. D. F. Herring, Ren Chiba, et al. (Univ. of Wisconsin, Madison). Phys. Rev. 112, 1210-16(1958) Nov. 15.

The $N^{14}(\alpha,\alpha)N^{14}$ and $N^{14}(\alpha,p)O^{17}$ differential cross sections were measured for α-particle bombarding energies from 2.0 to 3.8 Mev. A differentially pumped gas scattering chamber was used. The $N^{14}(\alpha,\alpha)N^{14}$ differential cross sections were measured at center-of-mass angles of 170.8°, 140.6°, 125.1°, and 91.0°. Resonances were observed at 2.351, 2.370, 2.767, 2.868, 2.870, 3.080, 3.576 Mev and ~3.67 and ~3.71 Mev. The $N^{14}(\alpha,p)O^{17}$ differential cross sections were measured for α-particle bombarding energies from 2.7 to 3.8 Mev at center-of-mass angles of 169.7°, 135.6°, 119.0°, and 84.7°. Resonances in the $N^{14}(\alpha,p)O^{17}$ differential cross section were observed at α-particle bombarding energies of 2.868, 3.080, and 3.69 Mev. (auth)

8141

ENERGY LEVELS OF F^{18}. D. F. Herring (Univ. of Wisconsin, Madison). Phys. Rev. 112, 1217-24(1958) Nov. 15.

The $N^{14}(\alpha,\alpha)N^{14}$ differential cross sections reported in the previous paper were analyzed using the dispersion formalism to obtain properties of the energy levels of F^{18}. A detailed fit of the calculated cross section to the experimental data was possible for the two broad resonances in the 3-Mev (lab) region. The 3.7-Mev (lab) anomaly cannot be accounted for by a single level. For the remaining levels, a detailed fit of the calculated cross section to the experimental data was not attempted. It was possible, however, to restrict the J values and parity of these levels by a qualitative inspection of the data. (auth)

8142

Al^{26} DECAY SCHEME. James M. Ferguson (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. 112, 1238-40(1958) Nov. 15.

The energies and intensities of the beta and gamma radiations from the long-lived ground level of Al^{26} were studied with scintillation spectrometers. The positron spectrum was obtained using a plastic scintillator with 4π geometry and was found to have a forbidden shape and an endpoint of 1.160 ± 0.008 Mev. The positrons are in coincidence with a gamma ray with an energy of 1.84 ± 0.01 Mev, which is presumably from the first excited level of Mg^{26}. There is also a weak gamma ray with an energy of 1.10 ± 0.05 Mev, in coincidence with the 184-Mev gamma ray, and with an intensity of 0.03 relative to the 1.84-Mev gamma ray. This would be from the second excited level of Mg^{26}, to which the Al^{26} decays weakly by electron capture. No other gamma rays are observed. It appears that a peak in the pulse-height spectrum at 700 kev is due to scattering effects rather than a gamma-ray photopeak. (auth)

8143

DECAY OF Ag^{110m}. E. G. Funk, Jr., and M. L. Wiedenbeck (Univ. of Michigan, Ann Arbor). Phys. Rev. 112, 1247-51(1958) Nov. 15.

The gamma rays from Ag^{110m} were studied in magnetic spectrometers. Twenty-two electron lines corresponding to 14 gamma transitions were observed. These gamma rays were arranged in a plausible decay scheme. Directional correlation measurements were carried out on six gamma cascades in Cd^{110} resulting in spin assignments for 4 levels and multipolarity assignments for the strong gamma transitions. (auth)

8144

$N^{15}(p,n)O^{15}$ REACTION STUDY. K. W. Jones, L. J. Lidofsky, and J. L. Weil (Columbia Univ., New York). Phys. Rev. 112, 1252-6(1958) Nov. 15.

The excitation curve for the $N^{15}(p,n)O^{15}$ reaction at zero degrees was measured from threshold at 3.78 Mev to 6.38 Mev bombarding energy. Resonances corresponding to excited states in O^{16} at 16.21, ~16.3, ~17.0, 17.13, 17.29, ~17.5, 17.63, 17.84, 17.97, and 18.05 Mev were observed. The 16.21-Mev state is $J^{\pi} = 1^{+}$ and the 16.3-Mev state is $J^{\pi} = 0^{-}$. The energy difference between the $N^{15}(p,n)O^{15}$ threshold energy and the $Li^{7}(p,n)Be^{7}$ H_2^{+} beam thick-target threshold was found to be 17.6 ± 0.5 kev. A threshold energy for $N^{15}(p,n)O^{15}$ of 3.7808 ± 0.0011 Mev is implied if possible differences in the extrapolated end points of the $Li^{7}(p,n)Be^{7}$ thresholds with H^{+} and H_2^{+} beams are ignored. (auth)

8145

DECAY OF Cu^{62}. J. W. Butler and C. R. Gossett (U. S. Naval Research Lab., Washington). Phys. Rev. 112, 1257-63(1958) Nov. 15.

A source of Cu^{62} was prepared by means of the (p,γ) reaction on an enriched Ni^{61} target. The gamma rays following positron emission were detected with a scintillation spectrometer, and the following energies were measured: 0.88 ± 0.01, 1.13 ± 0.02, and 1.17 ± 0.01 Mev. The relative intensities with respect to the positrons are 0.3, 0.1, and 0.5% with uncertainties of a factor of two either way. Coincidence techniques and half-life measurements were used to identify the gamma rays with the decay of Cu^{62}. The half-life for positron emission was measured to be 9.9 ± 0.2 min. Branching ratios and log ft values have been calculated and are listed in tabular form. (auth)

8146

(n,t) CROSS SECTIONS FOR B^{10}, B^{11}, AND Be^{9}. Marvin E. Wyman, Edward M. Fryer, and Munson M. Thorpe (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 112, 1264-6(1958) Nov. 15.

A measurement of the (n,t) cross sections for Be^{9}, B^{10}, and B^{11} is described. The tritium yield was determined by absolute counting of the beta activity. Neutron fluxes were measured by standard techniques. The following values were obtained for the (n,t) cross sections at the indicated neutron energies: Be^{9} at 14.1 Mev, 18 ± 1.5 mb; B^{10} at 4 Mev, 95 ± 10 mb; B^{10} at 5.6 Mev, 230 ± 25 mb; B^{10} at 9.6 Mev, 125 ± 15 mb; B^{10} at 14.1 Mev, 85 ± 6 mb; B^{10} for fission spectrum, 30 ± 2 mb; B^{11} at 14.1 Mev, 15 ± 5 mb. (auth)

8147

ELASTIC SCATTERING OF 1.6-Mev GAMMA RAYS FROM H, Li, C, and Al NUCLEI. Luis W. Alvarez, Frank S. Crawford, Jr., and M. Lynn Stevenson (Univ. of Calif., Berkeley). Phys. Rev. 112, 1267-73(1958) Nov. 15.

The elastic scattering of 1.6-Mev gamma rays from H, Li, C, and Al was measured at an angle of 124°. The ratios of the measured differential cross sections to the classical Thomson differential cross sections are 0.94 ± 0.16 for H, 0.92 ± 0.10 for Li, 1.06 ± 0.10 for C, and 1.15 ± 0.10 for Al. These results agree with the field-theory prediction that in the low photon-energy limit the cross section must approach the classical Thomson cross section. (auth)

8148

SCATTERING OF POLARIZED μ MESONS FROM EXTENDED NUCLEI. George H. Rawitscher (Univ. of Rochester, N. Y.). Phys. Rev. 112, 1274-81(1958) Nov. 15.

Scattering solutions of the Dirac equation for a muon in the static electric field of an extended nucleus are numerically obtained for various values of the velocity of the incident particle (β = 0.4 to 0.8) and of the charge of the scattering nucleus (Z = 48 and 80). A Stanford Fermi-type shape for the extended nuclear charge distribution is assumed. Angular distributions of the unpolarized cross section and of the left-right scattering asymmetries (S) of a transversely polarized beam of μ^{+} and μ^{-} mesons are presented. For μ^{-} the finite nuclear size strongly reduces S in the forward directions. The reduction of the cross section seems to be more sensitive to the detailed shape of the charge distribution than is the reduction of S. In the case of μ^{+}, S is appre-

ciably altered from the point value, and can depend sensitively on the shape of the nuclear charge distribution. The value of S can be larger for the extended nucleus than for the point nucleus. (auth)

8149

HIGH-ENERGY ELECTRON SCATTERING FROM LITHIUM-6. George R. Burleson and R. Hofstadter (Stanford Univ., Calif.). Phys. Rev. 112, 1282-6(1958) Nov. 15.

The Li^6 nucleus was studied at 426 Mev by electron scattering methods between laboratory angles of 33° and 57.5°. Absolute values of the Li^6 cross sections were obtained by comparison with scattering measurements made on the proton at 426 Mev and 40°. Unique values of the experimental form factors are given in tabular form. The results are analyzed in terms of various possible charge distributions. Several examples of models showing a good fit are presented and appropriate radius and skin thickness values are given. Several unsuccessful models are also discussed. (auth)

8150

(p,pn) REACTIONS AT PROTON ENERGIES FROM 0.3 TO 3.0 Bev. Sanual S. Markowitz (Princeton Univ., N. J. and Brookhaven National Lab., Upton, N. Y.) and G. Friedlander (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 112, 1295-1302(1958) Nov. 15.

Cross sections for (p,pn) reactions on N^{14}, F^{19}, Fe^{54}, Ni^{58}, Cu^{63}, Cu^{65}, Zn^{64}, Mo^{100}, and Ta^{181} were measured at proton energies of 0.4 and 3.0 Bev. For F^{19}, Cu^{65}, Mo^{100}, and Ta^{181} cross-section measurements at several other energies between 0.3 and 3.0 Bev are reported also. Within 30%, all these (p,pn) cross sections appear to be energy-independent in this range. At a given energy the cross sections show greater variations from nucleus to nucleus than can be explained on a purely statistical picture of knock-on processes. Among the lightest nuclei (C^{12}, N^{14}, O^{16}, Fe^{19}), these variations can be correlated with the energy of the lowest lying level of the product nucleus which is stable with respect to particle emission. Among heavier nuclei this correlation disappears, and it is suggested that shell structure effects may be responsible for the fact that the (p,pn) cross sections of Cu^{63}, Cu^{65}, and Zn^{64} are about 45% higher than those of Fe^{54} and Ni^{58}. Apart from these individual variations which a statistical theory could not be expected to reproduce, it is found that the recent Monte Carlo calculations of intranuclear cascades by Metropolis et al. do not even predict the right magnitude and energy dependence for the cross sections. The calculated cross sections are too small by factors of 2 to 3 at 0.4 Bev and show a decrease with increasing energy. Possible reasons for these discrepancies are sought in details of the nuclear model used in the calculations. Various mechanisms which may contribute to (p,pn) reactions are discussed. It is concluded that deuteron emission cannot contribute significantly at the energies considered. Processes involving evaporation of one of the nucleons are likely to decrease in importance with increasing energy, whereas the contribution of meson reactions, such as (p,pnπ^0), (p,2pπ^-), etc., probably increases with energy. The observed energy independence of the cross sections may result from accidental cancellation of such opposing trends. (auth)

8151

FORMATION OF Be^7 IN INTERACTIONS OF VARIOUS NUCLEI WITH HIGH-ENERGY PROTONS. E. Baker, G. Friedlander, and J. Hudis (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 112, 1319-21(1958) Nov. 15.

Cross sections are reported for the formation of Be^7 in interactions of C, Al, Cu, Ag, and Au with protons of energies between 1 and 3 Bev. They are compared with previous data at 0.34-Bev proton energy. The carbon cross section is strikingly constant at 11 to 14 mb from 0.1 to 3.0 Bev. The other cross sections rise with increasing proton energy and are all in the neighborhood of 10 mb at 3 Bev. Beryllium-7 may be considered as a spallation residue from carbon, and the same mechanism probably accounts for at least a large part of its formation from Al. However, Monte Carlo calculations show that this mechanism predicts much too low cross sections from the higher Z targets. Other mechanisms must be invoked, the most promising being the evaporation of Be^7 nuclei. (auth)

8152

Be^7 NUCLEI AS EVAPORATED PARTICLES IN HIGH-ENERGY REACTIONS. J. Hudis (Brookhaven National Lab., Upton, N. Y.) and J. M. Miller (Brookhaven National Lab., Upton, N. Y. and Columbia Univ., New York). Phys. Rev. 112, 1322-5(1958) Nov. 15.

The probability for the emission of Be^7 nuclei in an evaporation process has been calculated. These calculations support the hypothesis that the Be^7 produced in high-energy proton irradiation of copper, silver, and gold as described in the previous paper, is formed directly by an evaporation process. (auth)

8153

SPIN-LATTICE RELAXATION TIME FOR I^{127} IN KI IN THE TEMPERATURE RANGE 2°K TO 20°K. C. V. Briscoe and C. F. Squire (Rice Inst., Houston, Texas). Phys. Rev. 112, 1540-3(1958) Dec. 1.

The spin-lattice relaxation time, T_1, for I^{127} in both single crystal and powdered KI was measured in the temperature range 2 to 20°K using a Pound-Watkins type nuclear magnetic resonance spectrometer. In the liquid hydrogen temperature range T_1 is approximately the same for both the single crystal and the powder specimens, varying from 20 sec at 20°K to 70 sec at 14°K. Both the temperature dependence and the magnitude of T_1 in this temperature range can be explained on the basis of a theory of nuclear quadrupolar spin-lattice relaxation proposed by Van Kranendonk. In the liquid helium temperature range (2 to 4°K), T_1 is constant within experimental error. For the single crystal $T_1 = 6.9 \times 10^3$ sec and for the powder specimen $T_1 = 6.0 \times 10^2$ sec in this temperature range. These values of T_1 are less by orders of magnitude than is predicted using Van Kranendonk's theory. The I^{127} resonance (spin $I = 5/2$ in units of $\hbar$) consisted of a narrow (less than 1 gauss half-width) central line with broad (>15 gauss) weak wings. This is attributed, according to Pound, to a shift in the nuclear magnetic energy levels brought about by the interaction of the nuclear quadrupole moment with electric field gradients present in the specimens. (auth)

8154

NUCLEAR MAGNETIC RESONANCE IN CEROUS MAGNESIUM NITRATE AT TEMPERATURES BELOW 1°K. T. L. Estle, H. R. Hart, Jr., and J. C. Wheatley (Univ. of Illinois, Urbana). Phys. Rev. 112, 1576-86(1958) Dec. 1.

The nuclear resonance of the proton in cerous magnesium nitrate, $Ce_2Mg_3(NO_3)_{12} \cdot 24H_2O$, was studied in a single crystal cooled to temperatures below 1°K by

partial adiabatic demagnetization and adiabatic rotation. The area under the nuclear resonance was used as a thermometric parameter. The area did not obey Curie's law as a result of the temperature-dependent local rf field. A $T-T^*$ relation was derived which gave temperature ratios on adiabatic rotation which agreed within 5–10% with ratios calculated from the properties of the crystal. The lowest measured temperature was 5×10^{-3}°K. A study of the structure of the resonance showed that the splittings were caused by the average magnetization of the cerium ions and that the protons were at least 5 A from the cerium ions. (auth)

8155

MEASUREMENTS OF THE INTERACTION OF 95-Mev PROTONS WITH He^4. W. Selove and J. M. Teem (Harvard Univ., Cambridge, Mass.). Phys. Rev. 112, 1658-66(1958) Dec. 1.

Elastic and inelastic scattering and the (p,d) "deuteron pickup" process were studied using a proton beam of about 95 Mev incident on a liquid helium target. The elastic scattering shows a nuclear-Coulomb interference dip at 9°, a slight diffraction-type minimum at about 57°, and a deep minimum, approximately 10^{-29} cm^2/sterad at 135°. (All angles and cross sections are in the center-of-mass system.) Inelastic scattering spectra were obtained at laboratory angles of 10°, 15°, and 30°. These spectra are characterized by broad peaks, roughly 10-Mev wide, centered around an energy about 6 Mev below the upper kinematical limit for inelastic scattering. Their interpretation is discussed qualitatively both in terms of quasi-elastic nucleon-nucleon scattering and in terms of strong interaction between parts of the dissociated α particle in virtual or continuum states. A minimum was observed in the $He^4(p,d)He^3$ differential cross section at about 29°. Analysis of the (p,d) data at 95 Mev and 32 Mev in the "transparent nucleus" Born approximation yielded inconsistent results; presumably this inconsistency is due to the failure of the model at the lower energy due to the tightly bound structure of He^4. (auth)

8156

PROTON ANGULAR DISTRIBUTIONS FROM $Zn^{64, 66, 67, 68}$ (d,p) REACTIONS. F. B. Shull and A. J. Elwyn (Washington Univ., St. Louis). Phys. Rev. 112, 1667-72(1958) Dec. 1.

Angular distributions and Q values were determined for proton groups from (d,p) reactions with isotopically enriched targets of Zn^{64}, Zn^{66}, Zn^{67}, and Zn^{68}. The incident deuteron energy was 10 Mev. The angular distributions were fitted by Butler curves, from which values of l_n were determined, where $l_n\hbar$ is the orbital angular momentum of the captured neutron. The fits were only fair, presumably because the Butler theory cannot be expected to give good fits at Z = 30 without modification. In addition, several peaks are evidently superpositions of closely spaced, unresolved groups with different l_n. Well-resolved empirical distributions which appear to correspond to l_n = 0, 1, 2, 3, and 4 were observed; these serve to indicate in which direction the Butler curves should be shifted, thus increasing confidence in the correctness of the values of l_n which were assigned. For Zn^{64}(d,p) we find Q = 5.71 Mev with l_n = 1 and 3, Q = 4.89 Mev with l_n = 1 and 3 or 4, Q = 4.43 Mev with l_n = 2, Q = 3.86 Mev with l_n = 0, and Q = 3.31 Mev with l_n = perhaps 2 and 4. For Zn^{66}(d,p) the results were Q = 4.76 Mev with l_n = 1 and 3, Q = 4.38 Mev with l_n = 1 and 3 or 4, Q = 3.85 Mev with l_n = 2, and Q = 3.15 Mev with l_n uncertain. For Zn^{67}(d,p) we find Q = 8.01 Mev with l_n = 3, Q = 6.90 Mev with l_n = 1, Q = 6.13 Mev with l_n unknown, and Q = 4.52 Mev with l_n = perhaps 1 and 3. For Zn^{68}(d,p) the results were Q = 4.22 Mev with l_n = 1, Q = 3.78 Mev with l_n = 4, and Q = 3.40 with l_n = 2. (auth)

8157

(p,α) REACTIONS INDUCED BY 23-Mev PROTONS. Clyde B. Fulmer and Bernard L. Cohen (Oak Ridge National Lab., Tenn.). Phys. Rev. 112, 1672-8(1958)

The (p,α) reactions induced by 23-Mev protons in targets of a wide range of atomic number were studied by observing the outgoing alpha particles. Alpha-particle energy distributions and absolute differential cross sections were measured at 30, 60, 90, 120, and 150 degrees. For targets of atomic number $\lesssim$50, the energy spectra and angular distributions indicate that most of the alpha particles are produced in compound nucleus reactions; however, there is evidence that the Coulomb barriers of the excited compound nuclei are somewhat lower than those of ground state nuclei. The alpha particles from the heaviest elements and the high-energy parts of the spectra from lighter targets are strongly forward peaked and are produced by direct interaction reactions. Total (p,α) cross sections vary from 175 mb for Al to 3.8 mb for Pt. (auth)

8158

EVALUATION OF BREMSSTRAHLUNG CROSS SECTIONS AT THE HIGH-FREQUENCY LIMIT. U. Fano, H. W. Koch, and J. W. Motz (National Bureau of Standards, Washington). Phys. Rev. 112, 1679-83(1958) Dec. 1.

Recent experimental values for the bremsstrahlung cross section near the high-frequency limit with electron energies from 0.05 to 15 Mev and with target atomic numbers from 13 to 79 are compared with theoretical estimates. Calculations made to lowest order in Z/137 show large differences with the experimental results for large Z. Improved estimates, derived by detailed balancing arguments from more accurate photoelectric cross sections, agree reasonably well with the experimental results throughout the indicated range of electron energies and atomic numbers. (auth)

8159

MEASUREMENTS ON THE LONGITUDINAL POLARIZATION OF BETA RAYS FROM P^{32}, Y^{90}, Pr^{144}, Au^{198}, AND Bi^{210} (RaE). J. S. Geiger, G. T. Ewan, R. L. Graham, and D. R. MacKenzie (Atomic Energy of Canada Ltd., Chalk River, Ont., Can.). Phys. Rev. 112, 1684-91(1958) Dec. 1.

The polarization of the beta rays from five negatron emitters were studied by the method of Møller scattering in a magnetized NiFe foil. The scattered incident electron and the recoil electron from the target foil are detected in coincidence by two scintillation counters. The difference between the coincidence counting rates for the two directions of foil magnetization divided by the average rate gives a quantitative measure of the longitudinal polarization of the incident beta rays. Our experimental results are as follows: P^{32}, $P = -(0.94 \pm 0.06)v/c$; Y^{90}, $P = -(0.86 \pm 0.06)v/c$; Pr^{144}, $P = -(0.90 \pm 0.22)v/c$; Au^{198}, $P = -(0.98 \pm 0.18) \times v/c$; and for RaE, $P = -(0.69 \pm 0.10)v/c$. The first four results may indicate a polarization magnitude slightly less than full $-v/c$. The differences are, however, within the range of possible systematic errors. The result obtained with RaE is significantly lower than the average of the other four results.

This indicates a departure from $-v/c$ polarization for this nuclide. (auth)

8160

EXCITED STATES OF V^{51} AND Cr^{53}. M. Mazari, W. W. Buechner, and A. Sperduto (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. 112, 1691-3(1958). Dec. 1.

The region of excitation in V^{51} up to 4.12 Mev was investigated through studies of the inelastic scattering of protons. In this region of excitation, thirty-five excited states were found. The low-lying excited states of Cr^{53} were investigated through the $Cr^{52}(d,p)Cr^{53}$ and the $Mn^{55}(d,\alpha)Cr^{53}$ reactions. The ground-state Q values for these reactions are 5.720 ± 0.006 and 8.275 ± 0.008 Mev, respectively. The first two excited states in Cr^{53} are at 0.565 and 1.008 Mev. In these studies, the bombarding beam was provided by an electrostatic accelerator, and the reaction products were analyzed with a broad-range magnetic spectrograph. (auth)

8161

STEADY-STATE FREE PRECESSION IN NUCLEAR MAGNETIC RESONANCE. H. Y. Carr (Rutgers Univ., New Brunswick, N. J.). Phys. Rev. 112, 1693-1701 (1958) Dec. 1.

A steady-state free precession technique for observing nuclear magnetic resonance is described. A mathematical analysis is presented for certain special conditions, and initial experiments verifying the results of this analysis are reported. This technique provides two opportunities for improving the signal-to-noise ratio. First, it provides a mechanism, similar to that of the "spin echo," for eliminating the effect of the inhomogeneity of the magnetic field on signal strength. This permits the effective use of larger samples. In the second place it provides a steady-state signal which can be observed with a narrow-band detector. Under certain conditions the technique has a broad response as a function of frequency or field. The upper limit to the width of this response is determined by the electronic apparatus supplying the rf pulses rather than the magnet or the nuclear sample. (auth)

8162

LEVELS OF Cl^{33} FROM $S^{32}(p,p)S^{32}$ AND $S^{32}(p,p'\gamma)S^{32}$. J. W. Olness, W. Haeberli, and H. W. Lewis (Duke Univ., Durham, N. C.). Phys. Rev. 112, 1702-16(1958) Dec. 1.

Differential cross sections for the elastic scattering of protons from S^{32} were measured for the center-of-mass scattering angles 167.8°, 141.0°, 125.5°, 92.0°, and 63.9° for laboratory proton energies between 1.5 and 4.0 Mev. The cross sections for inelastic scattering to the 2.237-Mev level of S^{32} were also studied for incident proton energies between 2.7 and 3.8 Mev. These data were analyzed in terms of the single-level approximation of the dispersion theory. The results yield the following resonance energies (Mev) and assignments of spin and parity for the levels of the compound nucleus Cl^{33}: 1.900 ($\frac{3}{2}^-$), 2.310 ($\frac{1}{2}^-$), 2.578 ($\frac{5}{2}^-$, $\frac{7}{2}^-$), 2.810* ($\frac{3}{2}^-$), 2.895 ($\frac{1}{2}^-$), 2.902* ($\frac{5}{2}^-$, $\frac{7}{2}^-$), 2.917* ($\frac{3}{2}^+$), 3.094* ($\frac{5}{2}^-$), 3.195* ($\frac{5}{2}^+$), 3.273 ($\frac{1}{2}^+$), 3.379* ($\frac{7}{2}^-$), 3.480 ($\frac{3}{2}^-$) 3.570 ($\frac{1}{2}^+$), and 3.716* ($\frac{5}{2}^-$). Those resonances which exhibit observable widths for inelastic scattering are designated in the above tabulation by an asterisk. The analysis of the angular dependence of the inelastic cross sections supports the assignment 2^+ to the first excited state of S^{32}. (auth)

8163

4^+ EXCITED STATE IN OSMIUM-188. P. S. Fisher and R. A. Naumann (Princeton Univ., N. J.). Phys. Rev. 112, 1717-19(1958) Dec. 1.

Transitions in Os^{188} excited by K capture from 41-hour Ir^{188} were observed at 155, 324, 478, 633, 641, 827, 832, 1205, 1320, 1440, 1560, 1700, 1940, 2055, and 2190 kev. The new transition at 324 kev is in prompt coincidence with the 155-kev transition to the ground state, and an E2 assignment was made from conversion electron and gamma-ray intensities. It is proposed that this is the transition between a 4+ rotational level in Os^{188} at 479 kev and the 2+ state at 155 kev. (auth)

8164

NITROGEN-NITROGEN ELASTIC SCATTERING. Charles E. Porter (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 112, 1722-30(1958) Dec. 1.

An optical-model analysis of the measurements of nitrogen-nitrogen elastic scattering is made, and a quasi-classical discussion of the corresponding phase shifts is given. (auth)

8165

HIGH-RESOLUTION ELECTRON SPECTROSCOPIC STUDY OF THE 60-HOUR ELECTRON-CAPTURING ISOMER Re^{182}. C. J. Gallagher, Jr. and J. O. Rasmussen (Univ. of California, Berkeley). Phys. Rev. 112, 1730-45(1958) Dec. 1.

A thorough study of the conversion electron spectrum from electron capture decay of the 60-hr Re^{182} isomer is reported. A very large number of transitions are observed, including most of those reported by previous investigations on the beta decay of Ta^{182} to the same daughter nucleus W^{182}. In addition many new transitions are observed. Relative intensity comparisons from the present study add weight to a Ta^{182} decay scheme published by earlier investigators. Using the Ta^{182} decay scheme as a base, it was possible to fit most of the new transitions into a plausible decay scheme involving several new levels. A tentative grouping of many of the new levels into rotational bands is proposed, mainly on the basis of relative intensities of gamma transitions depopulating various levels. (auth)

8166

EFFECT OF A COMPLEX SPIN-ORBIT COUPLING ON THE POLARIZATION OF PROTONS ELASTICALLY SCATTERED FROM NUCLEI. R. M. Sternheimer (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 112, 1785-9(1958) Dec. 1.

The effect of a complex spin-orbit coupling on the polarization in elastic nucleon-nucleus scattering was investigated for the case of 150-Mev protons scattered from emulsion nuclei (Ag, Br, average Z = 41). The calculations were carried out for a fixed central potential V and a fixed real part U_r of the spin-orbit coupling, and with a variable imaginary part U_i of the spin-orbit coupling. It was found that the maximum polarization P_{max} inside the first diffraction peak increases somewhat with increasing U_i (from 0.55 for $U_i = 0$ to 0.76 for U_i with maximum value $U_{i,max} = 1.0$ Mev on the surface of the nucleus). The small negative values of the polarization P in the small-angle region of Coulomb scattering ($P \sim -0.02$) and the large negative values of P in the region of the first diffraction minimum are rather insensitive to changes of U_i. Calculations were also carried out for the polarization of 150-Mev protons scattered from carbon and lead. (auth)

8167

TIME-REVERSAL INVARIANCE AND PARITY CONSERVATION IN STRONG INTERACTIONS. L. Rosen

and J. E. Brolley, Jr. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Letters 2, 98-101(1959) Feb. 1.

In view of the failure of parity conservation in weak interactions, it is appropriate to investigate, under diverse situations, the degree to which strong interactions are invariant under the operation of time reversal and space inversion. One test of time reversal invariance can be derived from differential cross section measurements of inverse reactions. Two experiments to check time reversal invariance are described, and the results are presented. (W.D.M.)

8168

TIME-REVERSAL INVARIANCE AND THE INVERSE REACTIONS $C^{12} + \alpha \rightleftharpoons N^{14} + d$. D. Bodansky, S. F. Eccles, G. W. Farwell, M. E. Rickey, and P. C. Robison (Univ. of Washington, Seattle). Phys. Rev. Letters 2, 101-4(1959) Feb. 1.

The experiment described differs from the p-p experiments in that it also involves n-p forces and is in a quite different energy region. The angular distributions for the inverse reactions $C^{12}(\alpha,d)N^{14}$ and $N^{14}(d,\alpha)C^{12}$ were measured. The measurements were carried out using 41.7-Mev alphas and 20.0-Mev deuterons from the external beam of the University of Washington cyclotron. (W.D.M.)

8169

NEUTRON SPECTRA FROM $Be^9(He^3,n)C^{11}$ AND $Be^9(He^4,n)C^{12}$ USING PULSE SHAPE DISCRIMINATION IN AN ORGANIC SCINTILLATOR. A. E. Litherland, E. Almqvist, R. Batchelor, and H. E. Gove (Chalk River Labs., Ont., Can.). Phys. Rev. Letters 2, 104-6(1959) Feb. 1.

Some measurements on the suitability for pulse-shape discrimination of some commercially available organic scintillators are reported. Preliminary observations of the high-energy neutron groups from the $Be^9(He^4,n)C^{12}$ and the $Be^9(He^3,n)C^{11}$ reactions were made. (W.D.M.)

8170

SEARCH FOR AN 80-msec ACTIVITY IN LIGHT NUCLEI. D. E. Alburger, A. Elwyn, A. Gallmann, J. V. Kane, S. Ofer, and R. E. Pixley (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters 2, 110(1959) Feb. 1.

Samples of 0.5 to 1.5 g of Li, Be, B, B^{10}, and C were exposed to 15.5-Mev neutrons resulting from a 20-μa beam of 600-kev deuterons incident on a thick Zr–tritium target. The 21-msec B^{12} produced in the crystal was detected in the first series of experiments. Other activities observed include 0.17-sec Li^9 from the Be sample and 0.8-sec Li^8 plus 13.6-sec B^{11} from the B sample. Upper limits on the (n,p) cross sections for producing 80-msec activity in the various nuclides are given. (W.D.M.)

8171

DIFFRACTION NUCLEAR PROCESSES AT HIGH ENERGIES. A. I. Akhiezer and A. G. Sitenko (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Ukrain. Fiz. Zhur. 3, 17-34(1958) Jan.-Feb. (In Russian)

A review is presented for theoretical work on diffraction nuclear processes. (R.V.J.)

8172

GAMMA SPECTRA OF INELASTIC SCATTERING OF NEUTRONS. I. F. Barchuk, M. V. Pasechnik, and Yu. A. Tsybulko (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Ukrain. Fiz. Zhur. 3, 53-63(1958) Jan.-Feb. (In Russian)

A scintillation spectrometer with a NaI(Tl) crystal (60 mm in diameter and 50 mm in height) and a photomultiplier was used in measuring the γ spectra from inelastic neutron scattering in Al, Cu, Fe, Mg, Sb, and Sn at 2.8 Mev. A rough evaluation was made of γ intensities for each element. The neutrons were produced from the $D(d,n)He^3$ reaction in a low-voltage, horizontal type accelerator (140 to 150 kv) with a high-frequency ion source. An adsorption target was employed in order to reduce the γ-ray background. The pulse-height distribution was measured with a 50-channel amplitude analyzer. The spectrometer resolution was 6.5 to 8% for Co^{60} γ rays (1.17 to 1.33 Mev). (tr-auth)

8173

PHOTOPROTONS FROM VANADIUM. A. Halsteinslid, K. Nybø, and R. B. Møllerud. Univ. i Bergen Arbok Naturvitenskap. Rekke No. 15, 8p.(1958).

The angular and energy distributions of protons from vanadium irradiated by 30-Mev bremsstrahlung were measured by means of nuclear emulsions. The energy distribution has a maximum at 4 Mev and a similar shape as previously found for medium heavy elements. The medium energy protons show a clear asymmetry in the forward direction. (auth)

8174

THE MAGNETIC MOMENT OF THE 181-kev LEVEL OF TECHNETIUM-99. E. Bodenstedt, E. Matthias, and H. J. Körner (Physikalischen Staatsinstitut, Hamburg). Z. Physik 153, 423-39(1959). (In German)

The nuclear g-factor of the 181-kev level of Tc^{99} was determined by measuring the angular correlation of the 741–181 kev gamma-gamma cascade in an external magnetic field. The result, $g = +1.44 \pm 0.13$, yields a magnetic moment of 3.6 ± 0.3 nuclear magnetons for the spin assignment 5/2. A study of the disintegration confirmed the known decay scheme, but an additional gamma ray of 950 kev was found. Coincidence measurements proved that this γ ray is a transition to the 181-kev level. A new determination of the half life time of the 181-kev level confirmed the known value, but the limits of error were reduced to: $T_{1/2} = 3.57 \pm 0.05 \times 10^{-9}$ s. The angular correlation function of the 741-kev-181-kev cascade was measured as $W(\Theta) = 1 + (0.118 \pm 0.011) \times P_2(\cos\Theta) - (0.003 \pm 0.008) \times P_4(\cos\Theta)$ and the 741-kev-41-kev-140-kev triple cascade as $W(\Theta) = 1 - (0.164 \pm 0.013) \times P_2(\cos\Theta) + (0.003 \pm 0.007) \times P_4(\cos\Theta)$. The source was prepared as ammonium molybdate in liquid solution. Delayed coincidence measurements showed weak perturbations by internal fields. The results are discussed. (auth)

8175

NUCLEON AND RESIDUAL NUCLEAR POLARIZATION IN THE STRIPPING REACTION. Hans-Arwed Weidenmüller (Univ. of Heidelburg, Ger.). Z. Physik 153, 440-4(1959). (In German)

Under the usual assumptions of nuclear stripping theory, it is shown that the proportionality constant connecting the polarization of outgoing particles and of residual nuclei is determined by the quantum numbers of the initial and final states of the nucleus only. Therefore, a simultaneous measurement of both quantities provides a sensitive test of the validity of those assumptions without the necessity of detailed numerical calculations. The well-known theoretical properties of the nucleon polarization ($|P_{nucl}| \leqq 1/3$, P_{nucl} positive or negative, if $j = l + 1/2$ or $j = l - 1/2$) do not hold for the

nuclear polarization, the sign of which is independent of j and which may assume the value one. (auth)

8176

THE EFFECT OF PHENOMENOLOGICAL THREE-BODY FORCES ON THE SATURATION OF BINDING ENERGIES OF LIGHT NUCLEI. S. Sanatani (Univ. of Munich). Z. Physik 153, 508-22(1959).

With the help of an empirical two-parameter addition of the Gauss type for a three-body potential, the effect of such a force, added to the nonsaturated pure attractive two-body force, on the binding energy and stable radius of light nuclei with filled shells or with closed ±1 configurations was investigated. The calculation is based on the application of shell model wave functions without configuration mixing. There exists no value of the parameters to bring the binding energy and the stable nuclear radius into agreement with experiment. Since the approximation method used in the nuclei discussed must be satisfactory for regular potentials, the result is an answer against the assumption that a nonsingular repulsive three-body force be responsible for the saturation of the nuclear force. The nuclear radius is held constant, as in the usual two-body force calculations, so that the value $V_0' \approx 140$ Mev is obtained for the intensity V_0' of the three-body force in a given range $\approx 10^{-13}$ cm in the adjustment of the binding energy to the experimental values. (tr-auth)

8177

CONVERSION ELECTRON SPECTRA OF NEUTRON DEFICIENT LUTETIUM ISOTOPES. V. M. Kel'man, R. Ya. Metskhvarishvili, et al. (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz. 35, 1309-10(1958) Nov. (In Russian)

The energies of γ transitions in Lu^{169} and Lu^{170} with conversion line periods ~1.5 to 2 days and for Lu^{171} and Lu^{172} with γ transition period 6.7 to 8 days are tabulated. (R.V.J.)

8178

METINGEN MET EEN PROPORTIONELE TELLER BIJ BETA-DISINTEGRATIE. (Measurements with a Proportional Counter During Beta Disintegration.) Hendrik Lourens Hagedoorn. 's Gravenhage, Netherlands, Uitgeverij Excelsior, 1958. 69p.

The results of measurements of the L/K capture ratios of nuclei decaying by electron capture only and of the EC/β^+ ratios of nuclei decaying by both electron capture and positron emission are reported. The L/K ratio was studied for Pb^{203} and Tl^{202}, and the decay energies were found to be 930 ± 40 kev and 900^{+750}_{-150} kev, respectively. The ratio of electron capture to positron emission was determined for Na^{22}, V^{48}, and Ni^{57}. The fluorescent yield was measured for Tl^{48} and Co^{57}. The apparatuses used in the experiments are described in detail. (J.S.R.)

8179

NUCLEAR REACTIONS. VOLUME I. P. M. Endt and M. Demeur, eds. New York, Interscience Publishers Inc., 1959. 513p.

The nucleus as a many-body system is treated, and the shell model is discussed. The reactions of heavy ions and angular correlations and polarization are presented. Experimental and theoretical resonance reactions are presented. The statistical model and neutron resonanes in heavy nuclei are described. A survey of scattering and reaction experiments with medium energy nucleons and alpha particles is presented. The theory of rotational states in nuclei is included. (W.L.H.)

Theory

8180

COLLECTIVE EXCITATIONS OF NUCLEAR MATTER. A. E. Glassgold, Warren Heckrotte, and Kenneth M. Watson (Univ. of California, Berkeley). Ann. Phys. (N. Y.) 6, 1-36(1959) Jan.

A study of the collective motions of nuclear matter was made. First, a purely classical macroscopic description of hydrodynamic waves in nuclear matter is given, some experimental consequences of their excitation are suggested. Next a quantum mechanical study of the collective eigenstates of nuclear matter is taken up. The starting point of this discussion is the theory of the nuclear ground state as given by Brueckner and his collaborators. The excited states are described by means of the method developed by Sawada to apply to an electron gas. This method is generalized so as to include the internal degrees of freedom associated with spin and i-spin and to handle the momentum dependence of the level-shift operator K used by Brueckner. The connection between the quantum-mechanical eigenstates and the classical hydrodynamic motion is established. As a consequence of the internal degrees of freedom, there exist not only the usual compressive waves, but spin, i-spin, and coupled spin-i-spin waves. The i-spin waves can be associated with the Goldhaber-Teller oscillations. The corrections to the Sawada theory have been investigated. This gives rise to the damping of the stable Sawada collective eigenmodes, analogous to the viscous damping of a plasma oscillation. The spin and i-spin waves are only slightly damped, whereas the compressional mode is unstable in an exponentially growing sense. (auth)

8181

THE OSCILLATIONS OF A PLASMA ON THE BASIS OF THE EINSTEIN PRINCIPLE OF PULSES. Giovanni Lampariello. Atti acad. nazl. Lincei Rend. Classe sci. fis. mat. e nat. 22, 477-82(1957) Apr. (In Italian)

The question of whether there are electron oscillations in the case that the electron velocities in a plasma approach the speed of light is considered. (J.S.R.)

8182

OBSERVATIONS OF THE CYLINDRICAL WAVE OF MAGNETO-HYDRODYNAMICS. Giovanni Carini. Atti acad. nazl. Lincei Rend. Classe sci. fis. mat. e nat. 22, 482-8(1957) Apr. (In Italian)

It is shown how to utilize the Euler-Minkowski system for the study of the cylindrical waves of magnetohydrodynamics. (J.S.R.)

8183

A GENERALIZATION OF THE FOLDY-WOUTHUYSEN TRANSFORMATION. David Lurié. Bull. classe sci. Acad. roy. Belg. 44, 577-88(1958). (In French)

The Whittaker-Bhabba equations for a spin 1 particle are written out in Hamiltonian form using 12 × 12 matrices. By means of a appropriate extension of the Foldy-Wouthuysen transformation, the "odd" operators contained in the Hamiltonian are eliminated. The method used brings out a number of similarities between the present theory and those of Klein-Gordon and Proca. (auth)

8184
THE INVARIANCE OF MASS INVERSION AND THE FORM OF INTERACTIONS. Takehiko Takabayasi and Varadarata Venkata Raman. Compt. rend. 247, 2307-10 (1958) Dec. 22. (In French)

The hypothesis of invariance with respect to mass inversion, defined conventionally, along with the invariance of time inversion, leads uniquely to all known interactions between "old particles," those which conserve parity as well as those which don't. (tr-auth)

8185
PARITY SPACE OF THE ELECTROMAGNETIC FIELD. Takehiko Takabayasi. Compt. rend 248, 70-3(1959) Jan. 5. (In French)

The theory of the 4-component neutrino parity space is extended to the electromagnetic field. (J.S.R.)

8186
MAGNETIC FIELDS WITH FREE FORCE. John Carstoiu. Compt. rend 248, 73-5(1959) Jan. 5. (In French)

It is shown that the magnetic field with free force and its charge disappear with time. (J.S.R.)

8187
THE SYSTEMATIC ISOTOPIC DISPLACEMENT FOR HEAVY ATOMS. Nicolas Ionesco-Pallas. Compt. rend. 248, 199-202(1959) Jan. 12. (In French)

A general formula for the isotopic displacement of an electron level $S_{1/2}$ was obtained, and a representation was found so that all the displacements of heavy isotopes are placed on a universal curve. The theory agrees well with experimental results. (J.S.R.)

8188
IDENTIFICATION OF SOLUTIONS OF DIRAC EQUATIONS UNDER P, T, AND C. Kuo-Hsien Tzou. Compt. rend. 248, 375-8(1959) Jan. 19. (In French)

By a consideration of P, T, C, and their combinations as substitutions of variables, the solutions of the Dirac equations produced by these operators are identified. (tr-auth)

8189
VECTOR OF THE APPROXIMATE STATE OF THE NUCLEON COVERED IN THE INTERMEDIATE COUPLING APPROXIMATION. Jacques Mandelbrojt. Compt. rend. 248, 530-3(1959) Jan. 26. (In French)

The equation with vectors suitable for the Tomonaga approximation of intermediate coupling is replaced by a necessary and sufficient condition for which this approximation gives exactly the fundamental state of the nucleon considered as a fixed source. A system of equations is thus obtained which are resolved. (tr-auth)

8190
A REAL SPINOR FORMALISM IN THE THEORY OF THE ELECTRON. Parviz Merat. Compt. rend. 248, 533-5(1959) Jan. 26. (In French)

The four complex components of the Dirac spinor are replaced by eight real components. Two new potential quadrivectors are introduced beside the electromagnetic quadrivector of the electron without modifying the Møller and Bhabha formulas. (tr-auth)

8191
CHARGE SYMMETRY FOR WEAK INTERACTIONS. Takehiko Takabayasi. Compt. rend. 248, 535-8(1959) Jan. 26. (In French)

It is shown that the symmetry principle can be extended to weak interactions, leading to the VA type for Fermi interactions. (J.S.R.)

8192
QUASI-LATTICE MODEL OF NUCLEAR MATTER. L. E. H. Trainor, A. B. Bhati, and P. C. Sood (Univ. of Alberta, Edmonton, Can.). Nuclear Phys. 9, 287-95 (1958) Dec. (1).

Brueckner and others have applied an extension of the self-consistent method of Hartree-Fock to the determination of the properties of a hypothetical nuclear matter consisting of roughly equal numbers of neutrons and protons, the electrical forces between protons being "turned off." Taking the nucleon-nucleon interaction potentials to be those of Gammel and Thaler, we have applied the well-known Wigner-Seitz method for crystal lattices to a quasi-lattice model of nuclear matter. This method gives the energy of the lowest single particle state as a function of the internucleonic separation. Good agreement is obtained with the experimental values for the nuclear density and the binding energy per nucleon. (auth)

8193
ON A THEOREM CONCERNING THE SINGLE PARTICLE ENERGY OF A FERMI GAS WITH INTERACTIONS. C. Villi (Univ. of Trieste, Italy and Istituto Nazionale di Fisica Nucleare, Trieste, Italy). Nuclear Phys. 9, 306-13(1958) Dec. (1).

It is shown that the Hugenholtz and Van Hove theorem is a consequence of another theorem, which involves the existence of a hyperbolic partial differential equation, obeyed by the potential energy of a nucleon in an infinite sea of nuclear matter. The fundamental role played by this nuclear equation in describing the nucleus as a Fermi gas with interactions is discussed. (auth)

8194
SEMICLASSICAL TREATMENT OF DIRECT NUCLEAR REACTIONS. S. T. Butler, N. Austern, and C. Pearson (Univ. of Sydney). Phys. Rev. 112, 1227-38(1958) Nov. 15.

A semiclassical method is employed to discuss angular distributions of direct nuclear reactions. The method considers the incident and outgoing particles to be described by rays which follow classical paths; these rays can be refracted, reflected, and absorbed by a clouded-crystal-ball nucleus. Any given incident ray is considered to have a certain probability of suffering a major scattering at each point within a nucleus, this scattering not only changing the direction of the ray but also its wavelength. A condition of angular momentum conservation is imposed on this direct-scattering event, such that the angular momentum change in this process is equal to that required by the direct reaction under consideration. On this picture it is seen that the oscillations in the angular distributions which often occur with direct reactions arise as a result of interference between direct scatterings in different regions of the nucleus. Thus these oscillations are to be likened to the interference maxima and minima which arise when light is scattered, for example from a soap film. Effects due to compound nucleus absorption and of refraction and reflection of the incident and outgoing rays can be discussed fairly simply on this model. An investigation of the basis of the semiclassical method indicates that it should be reliable over a wide range of interesting conditions. (auth)

8195
SUPERPOTENTIALS FOR A GENERALLY COVARIANT FIELD THEORY. James L. Anderson (Stevens Inst. of

Tech., Hoboken, N. J.). Phys. Rev. 112, 1826-7(1958) Dec. 1.

An expression for the superpotentials corresponding to the energy-momentum complex of a generally covariant field theory is presented. It is somewhat more general than previous expressions in that it makes no special assumptions regarding the symmetry properties of the Lagrangian of the theory. (auth)

8196

THEORY OF SPIN-ORBIT INTERACTION IN NUCLEAR FORCES. Suraj N. Gupta (Wayne State Univ., Detroit). Phys. Rev. Letters 2, 124-5(1959) Feb. 1.

It has repeatedly been pointed out in recent years that a spin-orbit interaction between two nucleons is necessary to explain the observed scattering of nucleons. The existence of a hitherto unobserved neutron scalar meson has recently been predicted, the ρ^0 meson, which is coupled strongly to the nucleons. A comparison is made between the nuclear potential derived from this concept and the phenomenological value. (W.D.M.)

8197

V-A FOUR-FERMION INTERACTION AND THE INTERMEDIATE CHARGED VECTOR MESON. S. Oneda and J. C. Pati (Univ. of Maryland, College Park). Phys. Rev. Letters 2, 125-7(1959) Feb.

In order to forbid many unwanted reactions, it has been speculated that the weak Fermi interactions are realized through the interaction of a charged current with itself by exchange of a heavy charged boson. The simplest possibility is the introduction of a charged vector meson B_α. The possible existence of B_α is investigated further. Electromagnetic corrections are neglected. (W.D.M.)

8198

SHAPE OF THE NUCLEUS. Lawrence Wilets (Univ. of Washington, Seattle). Science 129, 361-7(1959) Feb. 13.

The gross features of nuclear morphology are summarized. Nuclei have shapes similiar to a diffuse-surface liquid drop. The constancy on nuclear density implies an $A^{1/3}$ law for the mean nuclear radius. Nuclear shapes can vary widely, with doubly magic nuclei preferring spherical symmetry. The collective and unified models are discussed. There is some evidence, based on the occurrence of "inversion" spectra and asymmetrical fission, that pear-shaped nuclei may exist. (W.D.M.)

RADIATION EFFECTS ON MATERIALS

Refer also to abstract 8451.

8199 D5-2880

Boeing Airplane Co., Seattle.

RADIATION DAMAGE TO TRANSISTORS. D. A. Hicks, D. V. Keller, J. B. Robison, R. K. Durkee, J. R. Orr, and B. M. Clarke. Dec. 1, 1958. 122p. Contract AF33(600)-35030.

Studies of the radiation damage to 23 transistor types have been carried out utilizing the Los Alamos critical assembly (Godiva II), The Materials Testing Reactor at Arco, and the University of Washington cyclotron. The transistor types included all power and frequency ranges for both silicon and germanium transistors. Neutron dosimetry was performed at each site and all transistors were pedigreed before and after irradiation by the Philco transistor laboratory. Plots are given showing the changes in the $1/\beta$ vs. I_e curves, and the I_{co} vs. temperature curves, as a function of the number of neutrons received per square centimeter. In addition, the collector characteristics are given in the low emitter current region for several neutron fluxes. The damage constant (K) for each transistor type was determined. The average values are $(4.2 \pm 0.2) \times 10^{13}$ nvt-μsec for n-base germanium, $(1.8 \pm 0.2) \times 10^{13}$ nvt-μsec for p-base germanium, $(3.1 \pm 0.4) \times 10^{12}$ nvt-μsec for n-base silicon, and $(4.6 \pm 3.3) \times 10^{12}$ nvt-μsec for p-base silicon. Larger K indicates smaller susceptibility to permanent radiation damage. (auth)

8200 IDO-16502

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

RADIATION DAMAGE STUDIES OF BORON STAINLESS STEEL. Final Report. W. O. Schaffnit. Jan. 28, 1959. 27p. Contract AT(10-1)-205. $1.00(OTS).

With the use of boron stainless steel in control rods in a reactor, it is important to know whether the operating conditions of temperature and radiation will effect changes in mechanical properties and dimensions and to know the magnitude of such changes if they occur. Tensile specimens of 18-8 stainless steel containing 1% boron, enriched to 93% in boron-10, were fabricated and irradiated in the Materials Testing Reactor to 15 and 25% burnup and in the Engineering Test Reactor to 40 and 90% of the boron-10 isotope. These were tested for tensile strength, hardness and elongation, and examined metallographically to observe changes in microstructure. The irradiated material was extremely brittle, changes were noted in the microstructure, and a crack was discovered in one of the higher burnup specimens. (auth)

8201 MRL-39

Watertown Arsenal. Materials Research Lab., Mass.

IRRADIATION EFFECTS ON CRYSTAL SURFACES. John J. Antal. June 1958. 14p.

A review is made of the work published or otherwise reported concerning the effects of radiation on the crystal structure of solid surfaces. The reviewed work is not extensive and is of recent origin. An analysis of the various experimental techniques which are available for surface structure studies is made with regard to their applicability in irradiation effects studies. (auth)

8202 NP-7093

Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio.

THE EFFECT OF NUCLEAR RADIATION ON TRANSISTORS. Technical Memorandum No. 5. K. E. Hassler, J. F. Hansen, and E. N. Wyler. Nov. 30, 1958. 15p. Project No. 2133. Contract AF33(616)-5171.

The types of problems to be expected in the use of transistors near nuclear reactors are considered. The information is presented in terms of changes occurring in the device parameters which are of interest to designers. The general effects which are considered include transient effects, which disappear upon removal of the radiation field, semipermanent damage, the effects of which usually disappear a few hours after removal of the radiation, and permanent damage. Silicon and germanium transistors are discussed, and it is pointed out that germanium is generally less susceptible to radiation than silicon. In addition to consideration of the material from which the transistor is made, other

factors to be considered are the transistor configuration, method of encasement, and the contents used to backfill the encasement. Graphic comparison of the sensitivity of germanium and silicon transistors to neutron- and gamma-induced damage is presented. (J.R.D.)

8203 NP-7184
Grumman Aircraft Engineering Corp., Bethpage, N. Y.
NEUTRON ACTIVATION RESEARCH ON SEAPLANE AIRFRAME MATERIALS. Bi-Monthly Report No. 1. M. D. D'Agostino and A. J. Favale. Sept. 1958. 8p. Contract NOas-58-729. (RE-92-PR-1).

The work done in the neutron activation research on seaplane airframe materials has so far been of a preparatory nature. Since it has been proposed to use a neutron source to irradiate a section from a salvaged seaplane hull bottom, a survey was made of available neutron sources. Based on cost, source strength and ease of handling considerations a Polonium-Beryllium source was selected. From published data on this source and the extrapolated results calculations were made to determine what counting statistics could be expected from the proposed experiment. These calculations indicate that at best the results from this particular set-up will be marginal. The composition of several types of steels and of aluminum and titanium alloys were also investigated for the purposes of determining optimum irradiation time and expected activities. (auth)

8204 NP-7250
Duke Univ., Durham, N. C.
DUKE MICROWAVE LABORATORY REPORT NO. 24 [FOR] NOVEMBER 1, 1958–FEBRUARY 1, 1959. 73p. Project No. R-357-10-6. Contract AF18(600)-497.

With this are bound: ELECTRON SPIN RESONANCE STUDIES OF RADIATION DAMAGE TO CERTAIN LIPIDS, HORMONES, AND VITAMINS. Harvey N. Rexroad and Walter Gordy. (AFOSR-TN-59-54; AD-209425). ELECTRON SPIN RESONANCE STUDIES OF RADIATION DAMAGE TO THE NUCLEIC ACIDS AND THEIR CONSTITUENTS. Howard Shields and Walter Gordy. (AFOSR-TN-59-53; AD-209424).

The method of electron spin resonance was applied to detect free radicals in the nucleic acids and their simpler constituents in an effort to learn something about the mechanisms of gene mutation. Preliminary results are described. The effects of x and γ rays on a number of hormones were also investigated by electron spin resonance, and preliminary results are described. Electron spin resonance was also used to study the effects of ionizing radiations on a number of vitamins. Details of the study are given. Some lipids closely related in structure to the steroid hormones were studied in the hope that the information gained would be useful in the interpretation of the results on the hormones. (For preceding period see NP-7183.) (A.C.)

8205 NP-7251
Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio.
MONTHLY ACCESSION LIST NO. 20 [ON RADIATION EFFECTS DATA]. Feb. 15, 1959. 26p. Project No. 2133. Contract AF33(616)-5171.

8206 NP-7287
Grumman Aircraft Engineering Corp., Bethpage, N. Y.
NEUTRON ACTIVATION RESEARCH ON SEAPLANE AIRFRAME MATERIALS. Bi-Monthly Report No. 3. M. D. D'Agostino and J. W. Nostrand, Jr. Jan. 1959. 7p. Contract NOas-58-729. (RE-92-PR-3).

Experimental procedures for the irradiation by a predominantly fast neutron flux of small specimens of seaplane airframe materials are presented. Some of the special equipment used in the previous activation study has been modified. (auth)

8207 NP-7316
Sylvania-Corning Nuclear Corp., Bayside, N. Y.
BIBLIOGRAPHY ON EFFECTS OF IRRADIATION ON SOLIDS. (Fifth Edition–1958). Helen C. Friedemann. 85p.

The fourth edition of this report was issued as NP-6237.

The bibliography contains 958 references, divided into three parts: theoretical aspects, effects on metals, and effects on nonmetals. Literature on biological effects, as well as on effects on liquids and gases, has not been included. It deals with metals, alloys, inorganic dielectrics, semiconductors, organic and polymeric materials, and especially the materials which are used in nuclear reactor components, such as fuel elements, moderators, coolants, control materials, and shielding. The extensive subject index at the end of the bibliography will be useful to provide ready reference to the literature. (auth)

8208 NYO-7625
Brown Univ., Providence.
RADIATION DAMAGE STUDIES IN SOLIDS; NUCLEAR RESONANCE ABSORPTION TECHNIQUE. Period covered: January 1, 1958 through October 31, 1958. P. J. Bray. Dec. 1, 1958. 16p. Contract AT(30-1)-1880. $3.30(ph), $2.40(mf) OTS.

Nuclear magnetic resonance (NMR) studies of neutron-irradiated LiF crystals have resulted in the detection of colloidal lithium metal and molecular fluorine gas. Quantitative determinations of the amount of damage and the behavior of the displaced metal and halide ions appear to be possible. The defect density in neutron-irradiated KBr has been checked as a function of dosage and annealing time. A low-intensity satellite on the low-frequency side of the normal bromine NMR in unirradiated KBr has been detected and studied as a function of the magnitude and orientation of the magnetic field. Second-order quadrupolar effects arising from the strain fields of dislocations are probably responsible for the effect. Experimental and theoretical studies of the preferential orientation of dislocations in single crystals of NaI and KI have progressed. With increased spectrometer sensitivity which detects the broad wings on the I^{127} NMR, integrated line intensities are now more meaningful. NMR studies of proton-irradiated (160 Mev) crystals of NaI, RbI, RbBr, CsI, CsBr and other alkali halides were started. The Li^7 and B^{11} resonances in $Li_2O-B_2O_3$ glasses were studied as a function of the glass composition. Departures from the behavior of the $Na_2O-B_2O_3$ system are noted. The Li^7 resonance displays satellite transitions arising from nuclei with electrical quadrupole coupling constants of an average value of 187 kc. Neutron radiation damage has been detected in the $Li_2O-B_2O_3$ glasses by NMR techniques. Gamma ray radiation effects in hexamethylenetetramine reveal a hyperbolic tangent dependence on radiation dosage and emphasize the importance of recombination processes in molecular solids. (auth)

8209 WADC-TN-56-474
Wright Air Development Center. Aerial Reconnaissance Lab., Wright-Patterson AFB, Ohio.

BIBLIOGRAPHY ON THE EFFECTS OF RADIATION. Elizabeth Hollaway. Oct. 30, 1956. 10p. (AD-110516).

This bibliography includes 63 references from report and published literature on radiation effects on materials used in electronic components. (L.T.W.)

8210

HARDENING OF COPPER SINGLE CRYSTALS IRRADIATED AT −195°C. M. J. Makin (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Acta Met. 6, 305-6(1958) Apr.

Single crystals of Cu were electropolished, sealed in silica quills, and irradiated in the Harwell reactor BEPO for one week at −195°C. The total dose of slow neutrons was 8×10^{17} n/cm^2, and the ratio of fast to thermal flux was about unity in the position used. After irradiation the specimens were stored in liquid nitrogen to allow the radioactivity to decrease and were then transferred to the tensile machine and tested at −195°C without permitting the temperature to rise. The stress-strain curves for the irradiated specimens are presented. (W.L.H.)

8211

THE LENGTH OF NUCLEAR QUADRUPOLE RESONANCE IN SOLIDS EXPOSED TO HIGH ENERGY RADIATION. Joseph Depireux, Jules Duchesne, and Albert Van de Vorst (Univ. of Liege). Bull. classe sci. Acad. roy. Belg. 44, 693-701(1958) (In French)

The radiation damage produced by gamma rays of Co^{60} and neutrons in $NaCl^{35}O_3$ and p-C_6H_4 Br_2^{79} is studied. The problem of the shape of the quadrupole resonance lines is discussed, and suggestions are made on the distribution of the field gradients and on the part played by the induced impurities in the protective effects. (auth)

8212

MODIFICATION BY THERMAL NEUTRON IRRADIATION OF THE SPECIFIC WEIGHT AND THE MODULUS OF ELASTICITY OF A BOROSILICATE GLASS. Jean Paymal, Micheline Bonnaud, and Pierre La Clerc. Compt. rend. 247, 2335-7(1958) Dec. 22. (In French)

The irradiation of a borosilicate glass by thermal neutrons causes an increase of 2% of the specific weight and 4% of the modulus of elasticity. The observation of the thermal recovery of the modifications thus obtained gives a possibility for the study of glass. (tr-auth)

8213

THE IRRADIATION OF CADMIUM SULFIDE MONOCRYSTAL PHOTOCONDUCTORS WITH 1.4-Mev PROTONS. Robert Barjon, Claude Brachet, et al. Compt. rend. 248, 83-6(1959) Jan. 5. (In French)

A cadmium sulfide photoconductor monocrystal exposed to a 1.4-Mev proton beam is the site of four phenomena: green luminescence, induced conductivity, permanent modification of its photoconductivity, and modification of its spectral response. (tr-auth)

8214

EFFECTS OF RADIOACTIVE EMISSION ON THE PHYSICO-CHEMICAL PROPERTIES OF SOLIDS. V. I. Spitsyn (Inst. of Physical Chemistry, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R. Otdel. Khim. Nauk No. 11, 1296-1302(1958). (In Russian)

Effects of radioactive emission of solids on the isotopic exchange, adsorption, and other processes in which they participate were studied. The influence of S^{35} β radiation intensity on sulfur exchange between solid potassium sulfate, labeled with S^{35}, and gaseous sulfur anhydride was investigated at 840° with K_2SO_4 preparations, differing in their specific activity. The effect of radioactivity on the rate of methylene blue adsorption from aqueous solutions by $BaSO_4$ precipitate was also investigated. (R.V.J.)

8215

EFFECT OF γ-RAY AND PILE IRRADIATION ON THE COERCIVE FIELD OF $BaTiO_3$. Issai Lefkowitz and Toshio Mitsui (Brookhaven National Lab., Upton, N. Y.). J. Appl. Phys. 30, 269(1959) Feb.

Five single crystals were pile-irradiated and five were exposed to Co^{60} gammas. A decrease of the coercive field was observed in all cases. The value of spontaneous polarization increased with exposure, indicating that defects produced by irradiation provide favorable conditions for polarization reversal. (D.E.B.)

8216

ON THE VISCOSITY OF IRRADIATED POLYMERS. I. Mitio Inokuti (Univ. of Tokyo). J. Phys. Soc. Japan 14, 79-85(1959) Jan.

The change of the intrinsic viscosity of a polymeric substance due to irradiation with high-energy radiations is discussed for various types of initial molecular size distributions. It is shown that the intrinsic viscosity can at first decrease in certain cases by irradiation, even if it reaches infinity finally at the gel point. It is further concluded that such a behavior of the intrinsic viscosity is possible, only if the initial molecular size distribution is sufficiently broad. (auth)

8217

EFFECTS OF DEUTERON BOMBARDMENT OF CdS SINGLE CRYSTALS. Shoji Tanaka and Toshio Tanaka (Univ. of Tokyo). J. Phys. Soc. Japan 14, 113-14(1959) Jan.

Bombardment of CdS crystals by 2-Mev deuterons caused a reduction in resistivity, an increase in photosensitivity, a slowing of photocurrent use and decay rates, and sharp drops in thermally stimulated currents and steady-state photocurrents. (D.E.B.)

8218

THE IRRADIATION OF PLASTICS. T. R. Manley (A. Reyrolle and Co., Ltd., Durham, Eng.). Research (London) 12, 42-6(1959) Feb.

The polymerization of plastics by the use of radiation is discussed. Most conventional plastics may be made by irradiation usually with improved properties. By the use of radiation, plastics may be modified, again giving improved properties. It is possible to produce by radiation entirely new plastics and new combinations of plastics with unique properties which cannot be produced by present methods. (W.L.H.)

RADIOACTIVE WASTE

8219 CF-57-10-129

Oak Ridge National Lab., Tenn.

PROPOSAL FOR INSTALLATION OF EQUIPMENT FOR TREATMENT OF ORNL HIGH LEVEL WASTE. I. R. Higgins. Oct. 24, 1957. 14p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

It is proposed that neutralized ORNL storage tank supernate waste be used as a feed for a waste processing development facility. An electrolytic cell can be installed to remove nitrate and ruthenium from the wastes prior to discharge to the soil disposal pits.

This eliminates the hazards of nitrate and ruthenium in the ORNL soil disposal pits. In addition, a continuous ion exchange unit can be installed to study the isolation of fission products from a portion of the waste stream. The total waste stream can be processed by the ion exchange if desired. A six to eight inch diameter continuous ion exchange contactor is considered sufficient to remove cesium, strontium, and rare earths from 5,000 to 10,000 gallons of waste per day. The estimated installed cost of such a unit is about $16,000. The labor and chemical operating cost at 100% overhead is estimated at $22.50 per day. Three types of electrolytic cells were considered. All of the cells remove about 90% of the ruthenium by plating on the cathode. It is expected that the degree of ruthenium removed may be increased by further laboratory development. The first cell type is the Ionics cell which converts $NaNO_3$ to NaOH and HNO_3 for recycle. The second is the nitrate reduction (or destruction) cell which produces caustic and ammonia gas, as studied by KAPL. The acid-base cell is favored because of a factor of 8 lower power consumption, and the nitric acid may be reused as well as sodium hydroxide. An acid-base cell with rectifier for 5,000 gallons per day of 0.3 M $NaNO_3$ waste is estimated at about $15,000. The operating cost with 100% overhead, including labor, electricity, and cell maintenance is estimated at $47.72 per day. Operations may be credited with $29 per day of caustic and $86 per day of nitric acid. If it is desired to isolate the ruthenium and not remove the nitrate, a simplified electrolytic cell may be used. Cell cost is estimated at ~80% of the acid-base cell and about one tenth the cost for a rectifier. About 90% of the ruthenium may be conveniently removed. Technetium is not considered a radioactive hazard, but recovery is considered because of its value and expected ease of recovery. Technetium is not scavenged and has a very great affinity for anion resin. At current prices it is estimated that 0.25 g per day of technetium is being discharged at ORNL, which at present prices is $7,000/day. (auth)

8220 ORNL-2557

Oak Ridge National Lab., Tenn. and Robert A. Taft Sanitary Engineering Center, Cincinnati.

REPORT OF THE JOINT PROGRAM OF STUDIES ON THE DECONTAMINATION OF RADIOACTIVE WATERS. Feb. 11, 1959. 72p. $1.00(OTS).

The development of the research program at ORNL, the physical plant, and the present status of the program are discussed. Consideration is given to probable sources of radioactive contamination in the environment and to the potential health hazard of such contamination in drinking water supplies. Among the sources discussed are the nuclear bomb, the atomic installations, and the Off-Commission users of radioisotopes. Experimental results indicate the extent to which natural agents (physical, chemical, and biological) may concentrate radioactive materials, thus removing them from the waste streams. The water decontamination findings in laboratory studies, pilot-plant studies, and tests of emergency water treatment units are discussed in relation to the treatment process involved. The degree of removal of radiocontaminants from liquids by water treatment plant processes is contingent upon a wide variety of factors associated with the chemical form of the contaminant and with the general nature of the liquid medium. Under emergency conditions the use of normal water treatment processes or feasible modifications thereof will provide some removal of radioactive material. However, such removal may or may not be adequate and should be evaluated on the basis of the MPC value for the individual radioisotopes or on the basis of the weighted MPC value for the mixture under consideration, in order to determine whether a health hazard exists. For the removal of individual radioisotopes from waters, modified treatment methods are set forth. The final section of the report describes the activities of the ORNL group and others in the development of radiation-measuring instrumentation to meet specific needs, and in the evaluation and adaptation of commercially available instrumentation for this purpose. Some consideration is given to the use of the latter to measure the concentration of radioactivity in water under emergency conditions. (auth)

8221 ORNL-2566

Oak Ridge National Lab., Tenn.

PHYSICAL CHARACTERIZATION OF ACIDIC AND NEUTRALIZED SYNTHETIC FUEL REPROCESSING WASTE SOLUTIONS ON EVAPORATION AND CALCINATION. F. M. Empson and I. R. Higgins. Feb. 17, 1959. 31p. Contract W-7405-eng-26. $1.00(OTS).

Five synthetic fuel reprocessing waste solutions have been subjected to physical and chemical treatments designed to reduce the volume and make the residue more suitable for storage or for further treatment prior to disposal. Evaporation of acidic wastes to dryness gave solid residues with volumes of 6.8% (of original waste volume) for Purex, 24% for TBP-25, 15% for STR, 9.2% for Darex, and 3% for SIR. Condensates were approximately the volume of the original waste. Calcination of these dried residues at 900°C gave reductions in weight (referred to dry residue) of 43% for Purex, 58% for TBP-25, 34% for STR, 9% for Darex, and 74% for SIR. Neutralization with NaOH gave slow-settling, poorly filterable precipitates. Precipitates from neutralization with $Ca(OH)_2$ settled more rapidly and could be filtered with less difficulty. None of the precipitates was considered suitable for commercial filtration equipment. A flocculating agent (IFA-313, Illinois Water Treatment Company) increased settling rates in some cases. Maximum settling rates were attained with SIR waste neutralized with $Ca(OH)_2$. Unfiltered, neutralized wastes were evaporated to dryness and produced residues having volumes of 10% to 50% of original waste volume. Evaporation of the neutralized waste might be more desirable from the standpoint of reducing the volatility of certain fission products and reducing corrosion of equipment. (auth)

8222 UCRL-8609

California. Univ., Berkeley. Lawrence Radiation Lab.

COMPARATIVE COSTS OF SEA DISPOSAL AND LAND BURIAL FOR THE RADIOACTIVE WASTES OF THE LAWRENCE RADIATION LABORATORY. Elmer Nielsen. Jan. 21, 1959. 22p. Contract W-7405-eng-48. $4.80(ph), $2.70(mf) OTS.

A study has been made of comparative costs of disposal of radioactive wastes at sea and by burial, taking into account such factors as loading, storage, and transportation by various means. (auth)

8223

DISPERSION OF RADIOACTIVE MATERIALS BY STREAMS. Jared J. Davis (General Electric Co., Richland, Wash.). J. Am. Water Works Assoc. 50, No. 11, 1505-15(1958) Nov.

Important factors that influence the dispersion of radioactive contamination in streams are discussed. Also, consideration is given to the sources of radioactivity in streams. The main potential sources of radioactive contamination in streams are: the mining and smelting of radioactive ores; effluents from atomic-products manufacturing; wastes from industrial, research, and medical users of radioisotopes; accidents involving radioactive materials or nuclear-powered apparatus; and fall-out from atomic detonations. The chemical and physical properties of radioactive materials that can influence their dispersion in streams include their state, mass, density, radioactive lifetime, chemical state, and the temperature of the effluent that bears them. Nonbiotic, limnological factors that can influence dispersion of radioactive contamination include stream morphology, flow volume, velocity, temperature, and water chemistry. The biota of a stream can significantly affect the dispersion of radioactive contamination by accumulating and retaining certain radioisotopes and by spreading the contamination through migration. (J.H.M.)

8224

RADIOACTIVE WASTE DISPOSAL. A. N. Marei. Priroda 47, No. 12, 47-50(1958) Dec. (In Russian)

An analysis is made of methods for the deactivation of gases, aerosols, and water and various methods of waste storage which prevent dissipation of radioactive waste. (R.V.J.)

REACTORS

General

Refer also to abstracts 8349, 8354, 8357, 8362, 8363, 8364, 8365, 8366, 8374, 8391, 8397, 8406, 8407, 8408, 8416, 8423, 8424, 8426, 8437, 8444, 8446, 8449, 8450, 8452, 8454, and 8456.

8225 A/CONF.15/P/1524

SOME CONSIDERATIONS OF THE SAFETY OF THE DIDO CLASS REACTORS. R. F. Jackson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 12p.

The broad principles upon which the safe design and operation of the DIDO class of highly enriched heavy water moderated research reactors are based are described. It is shown that the primary protection lies with reliable and well duplicated protective devices and with the elimination by good design and operation of any features which are likely to give rise to dangerous conditions. However, as a varied experimental program is contemplated with such a reactor, it was felt that a containment building should be provided. (W.D.M.)

8226 AECU-1986(Suppl.)

North Carolina State Coll., Raleigh. School of Engineering.

SUPPLEMENTARY REPORT ON HAZARDS, RALEIGH REACTOR. Dec. 11, 1956. Includes reprint: AUTOMATIC PERIOD CONTROL OF THE RALEIGH RESEARCH REACTOR. Harold A. Lamonds. Nucleonics 14, 88-94(1956). 116p. ([NCSC-46(Suppl.]). $18.30 (ph OTS); $6.00(mf OTS).

Excessive chloride corrosion resulted in the removal of Raleigh Reactor Core-1 and the initiation of design studies for the 20-kw Core-2. During the interim, it is planned to meet student training needs through the installation of a simplified temporary water boiler of 500 w. The design of this temporary core and the hazards of its operation are presented. Many of the components of this system are those used with Core-1 (described in AECU-1986). For these components, reference is made to the initial hazards summary. (D.E.B.)

8227 AECU-4007

[Argonne National Lab., Idaho Falls, Idaho].

RESULTS OF PARALLEL FLOW OSCILLATOR STUDIES. Progress Report No. 2. R. R. Smith, J. F. Boland, and F. W. Thalgott. Apr. 17, 1958. 41p. $7.80(ph), $3.30(mf) OTS.

Parallel coolant flow studies on EBR-I Mark III are reported, and data from previous series flow studies are refined. It is indicated that changing from series to parallel causes little or no change in the reactivity feedback. The characteristics of the negative power coefficient of reactivity are apparently identical in both cases, and the conclusions reached as a result of the series flow studies are still valid. (T.R.H.)

8228 AECU-4008

[Argonne National Lab., Idaho Falls, Idaho.]

OSCILLATOR RESULTS IN EBR-I, MARK III WITH FUEL RODS LOOSE: STEADY STATE TEMPERATURES FOR LOW POWER PARALLEL FLOW RUNS. Progress Report No. 3. R. R. Smith, J. F. Boland, and F. W. Thalgott. May 6, 1958. 13p. $3.30(ph). $2.40 (mf) OTS.

The results are summarized of oscillator studies on EBR-I, Mark III, at 515 kw under series flow with fuel elements in two of the seven core assemblies loosened. Steady-state temperatures for the low-power tests under parallel flow conditions and for 700 kw under series flow are also summarized. A significant positive temperature coefficient of reactivity was not found. (For preceding period see AECU-4007.) (T.R.H.)

8229 AEF-62

Aktiebolaget Atomenergi, Stockholm.

SAMMANFATTNING OVER DE MATNINGAR SOM GJORDES I SAMBAND MED UPPKÖRNING AV R-1 TILL 600 KW. (Survey of Measurements done in Connection with the Start-Up of R1 at 600 kw.) N. Berglund and B. Swenson. July 1956. 9p.

A brief survey is given of the measurements made during the start-up of R-1. The control and adjustment of the security system is briefly considered, and the thermal efficiency and temperature distribution of channel 9 were determined. (J.S.R.)

8230 AERE-R/M-221

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE COMPUTED FREQUENCY RESPONSE OF DIDO AND PLUTO AT LOW POWER. L. A. J. Lawrence. Nov. 1958. 15p.

The power deviation vs. reactivity frequency response of DIDO and PLUTO can be computed from reactor neutron production data. The method and scope of the calculation are indicated and the results given in the form of modulus and phase plots. The results show that the presence of photoneutrons significantly affects the performance of the reactor at very low frequencies. (auth)

8231 AERE-R/M-222

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

DIDO CONTROL SYSTEM: AN INVESTIGATION INTO THE USE OF D. C. INJECTION BRAKING OF THE COARSE CONTROL ARM DRIVING MOTOR. P. M. Lavelle. Dec. 1958. 8p.

An investigation into the use of d-c injection braking on the induction motors used for driving the coarse control arms in DIDO is reported. The application of d-c injection braking is found to improve the response of the coarse control arms by appreciably reducing the amount of overrun encountered in positioning the arms. The d-c injection braking involves the application of d-c to two of the three phase stator windings, the d-c being applied immediately the a-c input is disconnected. Various values of d-c braking current were used and the results are recorded. Phase-reversal braking has also been tried, and although faster acting, it is less attractive because it involves greater complexity. (auth)

8232 APAE-34(Vol. II)(Suppl. 1)

Alco Products, Inc., Schenectady, N. Y.

BI-METALLIC TUBE STEAM GENERATOR FOR APPR-1. VOLUME II. INSTALLATION PROCEDURES. Jan. 9, 1959. 11p. Contract AT(30-3)-327. $3.30(ph). $2.40(mf) OTS.

A procedure specification is presented for arc welding materials conforming to ASTM specifications A-53 steel pipe, A-83 boiler tubes, A-106 carbon steel pipe, and AISI type C-1022 aluminum treated steel pipe. (J.R.D.)

8233 APEX-446

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

SPERT I FUSE TRIGGER TESTS. PART I. REACTOR TESTS OF DEVELOPMENTAL TRIGGERS. R. L. Waterfield and S. N. Stilwell. PART II. DISCUSSION AND ANALYSIS OF DEVELOPMENTAL TRIGGERS. R. F. Spera and S. N. Stilwell. Jan. 1959. 46p. Contract AF33(600)-21102 and AT(11-1)-171. $1.50(OTS).

Types of fuse triggers and associated instrumentation used to find a rapid release mechanism for fuses used to insert boron poisoning into reactors are described. Three bimetal triggers, a fusible-disk trigger, and an explosive trigger were tested to determine which type would be the most effective. It was found that the snap-beam bimetal trigger was the fastest acting, followed by the large-helix bimetal trigger and then the fusible-disk trigger. A small helix coupled with a microswitch did not act until after peak power was reached. A comprehensive description and analytical evaluation of the trigger methods employed are included. Mathematical considerations used in the design of the triggers are given in an appendix. (auth)

8234 APEX-457

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

SIMPLE REACTOR RUNAWAY ANALYSIS. F. W. Mezger. Nov. 7, 1958. 42p. (XDC-58-11-210). $6.30(ph), $3.00(mf) OTS.

An IBM 704 FORTRAN program was written for the case of a reactor runaway for which the shutdown mechanism involves an excess reactivity, k_{ex}, which obeys the equation, $dk_{ex}/dt = \gamma p(t)$, $\gamma < 0$ where p(t) is the power level. Thus, the program is designed to treat runaways which are not extremely violet in nature including ones brought under control by a temperature coefficient. Four distinct stages of a runaway, the end of each of which can be determined by either a time, a power level, or an energy generated, are allowed. In the first three stages, any arbitrary combination of different step, linear, and accelerational reactivity changes can be inserted and in all four stages different reactivity coefficients, γ, can be defined. The iterative numerical techniques can be stopped when a certain maximum power, energy, or time is attained. In the case of a runaway that shuts itself down, a final minimum power level or final maximum time can also be used to stop the calculation by the machine. (auth)

8235 CF-59-1-31

Oak Ridge National Lab., Tenn.

A PRELIMINARY STUDY OF THE NUCLEAR STABILITY OF FLUIDIZED BED REACTORS. R. Benumof and M. W. Rosenthal. Jan. 12, 1959. 28p. Contract [W-7405-eng-26]. $4.80(ph), $2.70(mf) OTS.

A preliminary study was made of the nuclear stability of reactors in which particles containing U^{233} and Th^{232} are fluidized by liquid water. D_2O moderated reactors were found to be least sensitive to changes in bed height at thorium concentrations in the range 80 to 120 g/liter, H_2O reactors in the range 1500 to 2400 g Th/liter, and mixed H_2O–D_2O reactors at thorium concentrations between those for pure moderators. A reactor operated at the thorium concentration at which it is least sensitive to change in bed height was found to be stable in response to a cyclical variation in height. (auth)

8236 HW-57642

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

THE DECONTAMINATION OF REACTORS AND REACTOR LOOPS: A LITERATURE REVIEW. B. Griggs. Nov. 11, 1958. 22p. Contract W-31-109-Eng-52. $0.75 (OTS).

The purpose of this document is to assemble and organize the data on reactor decontamination in order to help in the development and selection of compatible materials and decontaminants. The decontamination of reactors and reactor loops containing stainless steel, carbon steel, and mixed stainless steel–carbon steel systems is presented. A bibliography of 71 references is included. (W.L.H.)

8237 HW-58678

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

CORRELATION OF EXPONENTIAL AND PCTR MEASUREMENTS ON CLUSTER FUEL ELEMENTS WITH THEORY. G. D. Joanou. Dec. 31, 1958. Decl. Feb. 11, 1959. 21p. Contract [W-31-109-Eng-52]. $4.80(ph), $2.70(mf) OTS.

Recent improvements in methods of lattice parameter calculation are reported. By refinement of conventional calculation methods, successful applications to cases of cluster fuel elements were found. The model used is described, and the resonance escape probability integral, fast effect, fission neutron release to neutron fuel capture ratio, and thermal utilization are calculated. In addition, the diffusion length and Fermi age were calculated as well as neutron streaming and density corrections. The experimental work is described, and a comparison of theoretical and experimental results is made. (J.R.D.)

8238 HW-59179
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
DIVISION OF REACTOR DEVELOPMENT PROGRAMS MONTHLY REPORT [FOR] JANUARY 1959. L. H. McEwen, comp. Feb. 15, 1959. 33p. Contract W-31-109-Eng-52. $6.30(ph), $3.00(mf) OTS.

The Al–Pu alloy capsules undergoing tests in the MTR and KER in-pile loops are discussed. Radiation effects on unsintered PuO_2–UO_2 powder irradiated in the MTR are discussed. Zircaloy fuel tubes loaded with pure Al rods were exposed in an autoclave at 400° and 1300 psig for 72 hours. The rods developed a 2-inch bow or permanent set. Fabrication of swaged cluster fuel elements for the PRTR was started. The first primary for the primary loop mockup was assembled and cold performance tests were run. Operation of the PCTR continued routinely during the first two weeks of the month. There were two unscheduled shutdowns, both due to electronic failure. (For preceding period see HW-58860.) (A.C.)

8239 IDO-10016
Idaho Operations Office, AEC.
ENVIRONMENTAL ASPECTS OF THE MATERIALS TESTING REACTOR OPERATION. Dec. 1952. Decl. Dec. 1, 1955. 122p. $19.80(ph), $6.30(mf) OTS.

With this are bound; Weather Bureau. METEOROLOGY OF MTR HAZARDS. P. A. Humphrey and E. M. Wilkins; and Geological Survey. GEOLOGY AND GROUND WATER AT SITE 2A, REACTOR TESTING STATION, IDAHO. J. R. Jones and P. T. Voegeli.

The U. S. Weather Bureau and the U. S. Geological Survey have each prepared a report for the MTR site. Considered in the Weather Bureau report are five basic types of stack gas behavior and fumigations accompanying the dissipation of nocturnal inversions. The report of the U. S. Geological Survey was developed from investigations directed primarily toward evaluation, development, conservation, and protection of ground water resources. (W.D.M.)

8240 IDO-16472
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
STANDARD PRACTICES GUIDE FOR WRITING EXPERIMENTAL OPERATING MANUALS. J. D. Ford, ed. Dec. 15, 1958. 32p. Contract AT(10-1)-205. $1.00(OTS).

A sample operating manual designed to aid experimenters in writing operating manuals for MTR and ETR experiments is presented. It contains what is felt to be the necessary information for operating a particular experiment. One of the main functions of an operating manual is to provide quick reference to material needed in an emergency. It is believed this type of manual provides the required information without an excessive amount of bulky, surplus material. (auth)

8241 IKB-C-B2
Institut für Kernforschung Berlin.
SICHERHEITSBERICHT FÜR DEN BERLINER FORSCHUNGSREAKTOR BER. 2. FASSUNG. (Safety Report for the Berlin Research Reactor BER. Second Report.) Oct. 1958. 138p.

The present report is an expanded and improved version of the safety report published in 1957. In addition to a description of the reactor and its properties necessary for operating safety, information is given on the reactor site, the reactor building, the ventilation and sewage systems, the operating regulations, and the organization. The possibilities and consequences of breakdown, in so far as they affect operating safety, are discussed. (J.S.R.)

8242 KAPL-M-S3G-RES-43
Knolls Atomic Power Lab., Schenectady, N. Y.
SURFACE, AVERAGE, AND MAXIMUM TEMPERATURES DUE TO HEAT GENERATION IN NUCLEAR REACTOR STRUCTURES. H. F. Larkin. Jan. 30, 1959. 36p. Contract W-31-109-Eng-52. $6.30(ph), $3.00(mf) OTS.

Graphs and formulas are presented for rapidly determining maximum, mean, and surface temperatures of nuclear reactor structures if the geometry, surface coefficients, and the heat generation are known. (auth)

8243 NACA-TN-4164
Lewis Flight Propulsion Lab., Cleveland.
TWO-DIMENSIONAL DIFFUSION THEORY ANALYSIS OF REACTIVITY EFFECTS OF A FUEL-PLATE-REMOVAL EXPERIMENT. Edward R. Gotsky, James P. Cusick, and Donald Bogart. Jan. 1958. 31p.

Effects of fuel plates successively withdrawn from the center fuel element of a seven- by three–core loading at the Oak Ridge Bulk Shielding Facility were evaluated by two-dimensional two-group diffusion calculations performed on the NACA reactor simulator. The two calculation methods used were: the slowing-down properties of the experimental fuel element were represented by infinite media parameters; the finite size of the experimental fuel element was recognized; and the slowing-down properties of the surrounding core were attributed to this small region. Reasonable agreement existed between experimental and calculated effects. (auth)

8244 NASA-M-12-8-58E
National Aeronautics and Space Administration. Lewis Research Center, Cleveland.
NASA REACTOR FACILITY HAZARDS SUMMARY. VOLUME I. T. M. Hallman and B. Lubarsky, eds. Oct. 15, 1956. 388p.

The reactor is light water cooled and moderated of the MTR-type with a primary beryllium reflector and a secondary water reflector. The core initially will be a 3 × 9 array of MTR-type fuel elements and is designed for operation up to a power of 60 Mwh. The reactor facility is described in general terms, and the nuclear characteristics and performance are discussed. The control system, fuel element handling, and waste disposal are described. The potential hazards involved with failures or malfunctions of this facility are considered in some detail. (W.D.M.)

8245 NP-7303
Technical Research Group, New York.
DESCRIPTION OF A NATURAL URANIUM REACTOR SUPPLYING HIGH TEMPERATURE HEAT. Francis H. Clark and Carl N. Klahr. July 1957. 30p.

A natural uranium reactor is proposed which is designed to combine the advantages of a natural uranium system with high generating system thermal efficiencies made possible by superheat from the reactor. The reactor is to have two power producing zones having different composition and properties. One zone, operated at relatively low temperature, affords sufficient reactivity for the entire system to be fueled with natural uranium. The other zone contains high-temperature materials and is the source of superheat supply. Computations establish that the proper balance of power

from the two zones required for a practical generating system can readily be achieved in reactor systems presently feasible. Two systems are dealt with in this investigation: (1) a sodium-gas system which is based entirely upon developed technology and for which detailed calculations are presented and (2) an all gas system which requires further development. (A.C.)

8246 ORNL-2659
Oak Ridge National Lab., Tenn.
RESONANCE ABSORPTION OF NEUTRONS IN NUCLEAR REACTORS (thesis). Lawrence Dresner. Mar. 10, 1959. 232p. Contract W-7405-eng-26. $3.50 (OTS).

Submitted to Princeton Univ.

The problem of resonance absorption of neutrons in nuclear reactors is considered. Formulas for the effective resonance integral of single resonances are given in the "narrow resonance" approximation in homogeneous media and in the "narrow resonance" and "infinite mass absorber" approximation in heterogeneous media. It is shown that the Doppler effect in homogeneous media can be expressed through a certain function of two variables, $J(\xi,\beta)$. The properties of this function are studied in detail, and a tabulation given. The effect of interference between resonance and potential scattering on the effective resonance integral is studied. In heterogeneous media in the "narrow resonance" case it is shown that the Doppler effect can again be expressed through the same function, $J(\xi,\beta)$, as in the homogeneous case if a rational approximation for the average escape probabilities due to Wigner is introduced. Furthermore, it is shown that then a formal identity exists between the homogeneous and heterogeneous cases for "narrow" resonances. The error caused by Wigner's rational approximation is studied in detail, and in the case of no Doppler broadening and no interference scattering an improved formula is suggested. In heterogeneous media in the "infinite mass absorber" case an approximate expression for the albedo of an absorber lump is suggested on the basis of heuristic arguments. Precise calculations of the albedo based on a variational method of solving the monoenergetic transport equation are compared with this approximation, and show it to be quite accurate. Use of the approximate albedo again permits expression of the Doppler effect through the function $J(\xi,\beta)$. The effect of interference between potential and resonance scattering is also studied in the "infinite mass absorber" approximation. These results are applicable to calculating the absorption in low energy resolved resonances for which the widths and energy are known. In the region beyond the experimental limit of resolution statistical considerations are employed. The formulas for single resonances are averaged over the probability distributions of the partial widths. The theory is then applied to the calculation of the effective resonance integrals of uranium and thorium rods, and good agreement is obtained for uranium and fair agreement for thorium. At high energies resonance absorption cross sections fall sufficiently low to permit neglect of flux depression effects, and attention is focussed on average reaction cross sections. A study of the effect of fluctuations in the partial widths on average reaction cross sections is given. Some general theorems are derived independent of the probability distributions of the widths. If the widths are distributed in member distributions of the chi-squared family, it is shown that the multiple integrals over these distributions which express the averages can be reduced to a single infinite integral. This integral is evaluated in the eighteen simplest cases of interest. A Monte Carlo program for the electronic computer ORACLE for evaluating these averages is described. It is shown that enough experimental data on neutron reactions in U^{238} exists below 500 kev to overdetermine the s-, p-, d-, and f-wave strength functions. Analysis of the data including the important effects of fluctuations in the widths yields consistent values for the strength functions, in support of the theory. Finally, the statistical formalism of Hauser and Feshbach is transformed from the channel spin representation to another which is more convenient in the presence of spin-orbit coupling. The effect of small amounts of spin-orbit coupling in the analysis of the U^{238} reaction data is found to be unimportant. Finally, it is proven that the total, the compound nucleus formation, and under certain circumstances, the radiative capture cross sections are independent in first order of spin-orbit coupling in the neutron-nucleus interaction. (auth)

8247 TID-3525
Technical Information Service Extension, AEC.
REACTOR SAFETY. A Literature Search. Richard J. Smith, comp. Feb. 1959. 20p. $0.50(OTS).

Included are references to 118 unclassified AEC research and development reports and 56 unclassified non-AEC reports. These references are presented on reactor systems, materials, and operation designed to provide maximum safety for the reactor, reactor personnel, and environs. Information is included concerning incidents and conditions of operation considered hazardous. (auth)

8248 TID-4100(1st Rev., Suppl. 2)
Technical Information Service Extension, AEC.
ENGINEERING MATERIALS LIST. A Catalog of Drawings, Photographs, and Specifications Released by the United States Atomic Energy Commission. Nov. 1958. 215p.

Available from TISE—free.

The Engineering Materials List (EML) is a catalog of available U. S. Atomic Energy Commission unclassified engineering drawing materials on the peaceful applications of atomic energy. The engineering literature described includes drawings, specifications, photographs, bill of materials, cost analyses, design criteria, parts lists, and related document references. This supplement identifies additional engineering materials that have been assembled into 50 new packages totaling approximately 2,350 drawings. In addition, this supplement contains a revision of the materials available on the Portable Scintillation Poppy—CAPE-147. The new cumulative Contents and Indexes cover all materials that have been announced in the EML to date (CAPE-1 through CAPE-206). The Indexes will enable the user to locate materials by names of the organizations which originated the material, by subjects, and by original identification numbers. (auth)

8249 WCAP-311(Rev.2 and Add.1)
Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
WESTINGHOUSE TESTING REACTOR CRITICAL EXPERIMENTS. APPLICATION FOR CLASS 104-C LICENSE. Hazards Summary Report. Oct. 1957. 81p. Addendum 1. Feb. 1958. 26p. $18.30(ph), $6.00(mf) OTS.

The Westinghouse Testing Reactor (WTR) critical

operation experiments were planned for location in a new annex at the present Westinghouse Reactor Evaluation Center. Radiation protection for personnel during the course of experiments is provided by underground location of the critical core in the Critical Experiment Station pit. The experimental reactor is a heterogeneous thermal-neutron type with water cooling and moderation. Safety has been enhanced by careful design and construction of the experimental facilities, the instrumentation, and the control system. A detailed discussion is presented of safeguards and precautions that have been taken to ensure the safe operation of the critical assembly. (C.H.)

8250

MANUFACTURE OF PRESSURE TUBE FUEL ELEMENTS WITH INTERNAL PROTECTIVE COATING. E. Bodmer, P. de Haller, and P. Sulzer. Atomwirtschaft 3, 491-5(1958) Dec. (In German)

Pressure-tube fuel elements with internal canning for heavy water moderated reactors with natural uranium offer the advantage of a decrease in cost compared with pressure containers and an essentially improved neutron balance compared with external pressure tubes. Elements prepared by a zone melting process in vacuo using a complex graphite mold show a metallic bond with satisfactory mechanical and anti-corrosion properties. (auth)

8251

ON THE "INFINITE DELAY" APPROXIMATION IN THE STUDY OF THE TRANSIENT OF A NUCLEAR REACTOR. U. Farinelli. Atti acad. nazl. Lincei Rend. Classe sci. fis. mat. e nat. 22, 606-10(1957) May. (In Italian)

Some general considerations on the limits of validity of the delayed neutron approximation for reactor transients are developed in a quantitative form. (J.S.R.)

8252

CRITICAL EXPERIMENTS ON THE AQUILON REACTOR. Y. Girard, J. C. Koechlin, and J. M. Moreau. Bull. inform. sci. et tech. No. 14, 14-22(1958) Feb. (In French)

The Aquilon is a natural uranium research reactor cooled with heavy water. The shielding, auxiliary installations, and the control installations are described. A study was made of the critical conditions of the reactor, and an experimental determination of the buckling was also performed. The values obtained are given. (J.S.R.)

8253

PROSERPINE. HOMOGENEOUS CRITICAL EXPERIMENT WITH PLUTONIUM. J. Tachon. Bull. inform. sci. et tech. No. 18, 16-21(1958) June. (In French)

The Proserpine, a zero power homogeneous reactor experiment with plutonium sulfate dissolved in light water, is briefly described. The lowest critical mass is 257.2 g of Pu. The vessel is of Zircaloy surrounded by a reflector of beryllium oxide. The absolute calibration of reactivity by poisoning with boron and the study of the temperature coefficient in different configurations were made. (J.S.R.)

8254

ANNEALING OF THE GRAPHITE OF THE G-1. M. Pascal. Bull. Inform. sci. et tech. No. 23, 11-12 (1958) Nov. (In French)

The technique used for the heating of the graphite of the G-1 Reactor is briefly described. The measurements made during the operation are being analyzed. (tr-auth)

8255

UTILIZATION OF NATURAL URANIUM FOR SUBMARINE PROPULSION. Francis Perrin. Compt. rend. 248, 33-5(1959) Jan. 5. (In French)

A discussion relative to the abandonment of natural uranium as the fuel for the first French submarine under construction, the Q244, is presented. (tr-auth)

8256

STUDIES OF THE AMBIENT RADIOACTIVITY WITH PARTICULAR CONSIDERATION TO THE PROBLEM OF SAFETY IN THE OPERATION OF NUCLEAR REACTORS. P. Caldirola (Univ. of Milan). Minerva nucleare 2, 333-5(1958) Nov. (In Italian)

The main problems connected with the safe use of nuclear reactors are discussed. The field of action, responsibilities, and duties of the health physicist are also briefly outlined. (auth)

8257

SPERT III GOES CRITICAL. Nuclear Power 4, 78-9 (1959) Feb.

The design of SPERT-III is presented. (W.L.H.)

8258

LIQUID METAL FUEL REACTOR EXPERIMENT. Hautache H. Poor (Babcock & Wilcox Co., Lynchburg, Va.). Nuclear Power 4, 84(1959) Feb.

A description of the 5000 kwt liquid metal fuel experimental reactor facility that will be built by Babcock and Wilcox is presented. The advantages and disadvantages of this type of reactor are presented. (W.L.H.)

8259

REMARKS ON THE PHYSICAL MEANING OF THE IMPORTANCE FUNCTION IN LINEAR REACTOR KINETICS. D. Emendörfer (Technischen Hochschule, Stuttgart). Nukleonika 1, 128-31(1958) Dec. (In German)

A consequence of the multigroup equations of linear reactor kinetics leads to the importance function of reactors with inclusion of delayed neutrons. For the case of the time-independent material constant, the physical significance of the importance functions was illustrated for critical and super-critical reactors. (tr-auth)

8260

DIFFUSION THEORY OF FINITE HETEROGENEOUS REACTOR LAYOUTS. B. Sturm (Siemens-Schuckertwerke AG, Erlangen, Ger.). Nukleonika 1, 131-9(1958) Dec. (In German)

The eigenvalue and the eigenfunction of a two-dimensional rectangular layout of fuel elements in a finite moderating medium were calculated, in which, in contrast to previously suggested methods, the resonance absorption was considered by the addition of suitable depressions to the source term of thermal neutrons. The consideration of the resonance absorption is of significance for the calculation of the eigenvalue of a perturbed lattice structure since in this case not only the thermal source, but also the resonance transition probability of the layout is altered. The correct reactivity change can be found only with incorporation of the resonance absorption. It was also shown that by a suitable generalization the experimentally determined source density distribution could be used for the calculation of the eigenvalues and eigenfunctions. (tr-auth)

8261

INVESTIGATION ON THE FUEL ELEMENT PLACING IN THE REACTOR AND ITS EFFECT ON THE BURN-

UP. A. Ziegler (Siemens-Schuckertwerke AG., Erlangen, Ger.). Nukleonika 1, 140-9(1958) Dec. (In German)

The variation of the fuel quality in the operation of the fuel charge in the reactor can be characterized by the three quantities Σ_f, Σ_a, and η. The spatial distribution of the elements of various ages can affect the maximum obtainable burnup and the power density. It is shown that it is possible through a suitable transposition plan to fulfill simultaneously three essential requirements. The proposed method guarantees a uniform burnup of all fuel elements, almost stationary distribution of the power density, and an optimum compromise between power density and burnup in the sense of the lowest kwh price. The method is nevertheless simple and adaptable. (tr-auth)

8262

REACTIVITY AND FLUX MEASUREMENTS ON THE MUNICH RESEARCH REACTOR (FRM). Hermann Hohmann, Rolf Misenta, et al. (Technische Hochschule, Munich). Nukleonika 1, 149-57(1958) Dec. (In German)

Measurements at low power are described, the results of which form the basis for the experimentation with reactors of the swimming-pool type. They concern the reactivity changes which occur in the lowering of the regulating rods and in the loading of fuel elements in the reactor. The local dependence of the thermal, epithermal, and fast flux is also considered. The fluxes were measured with gold or sulfur probes and determined absolutely with activation gages. Finally, the neutron spectrum of the reactor under simplifying assumptions was constructed. (tr-auth)

8263

SOME PROBLEMS OF PLUTONIUM FUEL CYCLES. M. Taube (Inst. of Nuclear Research, Warsaw). Nukleonika 3, 561-73(1958). (In Polish)

The role of nuclear fuel in fixing the costs of energy production in nuclear power stations is discussed. Classifications of types of fuel cycles and material balances for such cycles are given for the case of plutonium fuel. The specific power of the fuel and its connection with fuel cycles are characterized. (tr-auth)

8264

TEMPERATURE CALCULATIONS IN HETEROGENEOUS THERMAL NEUTRON REACTORS. A. Zmyslowski (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika 3, 615-31(1958). (In Polish)

The derivations are given of formulas for calculating the temperatures of coolant and cladding surface, the rise in temperature in the fuel element as a function of power produced in the fuel channel, and the distribution of thermal neutrons. The formula for the maximum temperature of the cladding surface is brought to the form given by Ginns. The temperature rise in a fuel element is discussed for the case of round rods and tubes since both cases are typical of the geometry of fuel elements hitherto used. The calculations are easily transposed for other fuel element shapes. (tr-auth)

8265

MEASUREMENTS AND STANDARDS OF RADIOACTIVITY. Proceedings of an Informal Conference Easton, Maryland, October 9-11, 1957. Nuclear Science Series Report Number 24. Washington, National Academy of Sciences—National Research Council, 1958. 162p. $1.75.

Information is included on the following: alpha measurements and standards, beta measurements and standards, gamma measurements and standards, electron capture nuclides and emitters of low-energy radiation, low-level counting, and standardization programs of various countries. (J.H.M.)

8266

SAFETY ASPECTS OF NUCLEAR REACTORS. C. Rogers McCullough, ed. Princeton, N. J., D. Van Nostrand Company, Inc., 1957. 246p.

This book is an edited collection of papers from the first Geneva Conference relating to the safety problem. Normal reactor and chemical plant operation problems both inside and outside the plants are discussed, and data are given on actual experience. The problem of determining safety standards to be adopted is considered. The abnormal behavior of reactors and the consequences are dealt with. Experiments on the effects of reactor supercriticality are covered. (W.D.M.)

8267

MATERIALS FOR NUCLEAR REACTORS. Bernard Kopelman, ed. New York, McGraw-Hill Book Company, Inc., 1959. 416p.

Fuel element material is considered, from ore through chemical reprocessing of irradiated, spent fuel elements. The properties, chemical, physical, and mechanical, of the many other materials that are found within a nuclear reactor are examined, including irradiation behavior. The broad categories of materials studied include fluids, moderators, shielding, and control rod materials. (W.D.M.)

Power

Refer also to abstract 8445.

8268 A/CONF.15/P/135

R 3—A NATURAL URANIUM FUEL HEAVY WATER MODERATED REACTOR FOR COMBINED ELECTRICITY PRODUCTION AND DISTRICT HEATING. P. H. Margen, H. Carruthers, B. Hargo, G. Lindberg, and B. Pershagen (A.B., Atomenergi Stockholm). 41p.

The design is described of Swedish Reactor (R-3), which will be used for supplying 70 Mw of heat to a district heating scheme and 15 Mw of electricity to the Swedish power system. Particular attention is given to mechanical and thermal engineering aspects of the design including a detailed analysis of the measures taken to prevent damage to the plant in the event of equipment failure occurring. The underground building is described in some detail. Results of reactivity calculations and optimization studies are included. (W.D.M.)

8269 A/CONF.15/P/185

ENGINEERING PROBLEMS OF A HORIZONTAL PRESSURE-TUBE REACTOR. R. M. Campbell and P. J. Collins (Canadian Westinghouse Co., Ltd., Hamilton, Ont.). 13p. (AECL-595). $0.25(AECL).

Some of the engineering problems encountered in pressure-tube reactors are outlined. Studies were focused on horizontal pressure-tube reactors, fuelled with natural uranium, moderated with heavy water at 38 to 93°C, and producing 400 to 600 Mw(t) at about 100 atmospheres and 270°C in the heavy-water coolant which flows through the pressure tubes. Comparisons with other pressure-tube systems are made. (W.D.M.)

8270 A/CONF.15/P/210
A HEAVY-WATER-MODERATED POWER REACTOR EMPLOYING AN ORGANIC COOLANT. M. J. McNelly (Canadian General Electric Co., Peterborough, Ont.). 22p. (AECL-620). $0.25(AECL).

The anticipated improvements in a D_2O-moderated reactor resulting from the use of an organic coolant are demonstrated by a preliminary design for a 150 Mwe power reactor using natural uranium fuel and a mixture of terphenyls as coolant. The reactor core is designed for a specific power rating of 20 kw/kg of natural uranium and a power density of 5.4 kw/liter of heavy water. The proposed operating conditions for the coolant are 296 to 427°C at 2.8 atm. A net efficiency of 33% and fuel costs of 1.0 to 1.5 mill/kwh are anticipated. (W.D.M.)

8271 A/CONF.15/P/246
SULZER PROJECT FOR A PROTOTYPE HEAVY WATER POWER REACTOR FOR LOCATION IN AN UNDERGROUND CAVERN. P. de Haller and A. F. Fritzsche (Sulzer Bros. Ltd., Winterthur, Switzerland). 51p.

The reasoning which led to the choice of a D_2O-moderated and -cooled pressurized reactor with slight enrichment is outlined, and a short description of the reactor is given. The fuel elements, the design of the reactor, and the fuel changing method chosen for the prototype plant are described. The containment philosophies applicable to an underground location are compared with those accepted for certain plants, now being built or in operation above ground, and the philosophy chosen for the prototype reactor plant is discussed. (W.D.M.)

8272 A/CONF.15/P/343
LAUNCHING A PROGRAMME OF PRESSURIZED GAS-COOLED REACTORS. J. Horowitz and J. Yvon (Commissariat à l'Énergie Atomique, Paris). 8p.

The natural uranium and plutonium system of power generation development is reviewed along with the use of compressed gas as a primary fluid. The EL-2, a natural uranium heavy water and compressed gas pile, and the G-1, a natural uranium graphite and atmospheric air pile, are examined in relation to their contribution to development. A number of factors governing investment costs and an economically acceptable utilization of fuels are reviewed in relation to gas cooled, graphite-moderated, and heavy water reactors. (J.R.D.)

8273 A/CONF.15/P/2094
NATURAL URANIUM AND HEAVY WATER REACTORS. F. Klik and J. Markvart (Czechoslovakia). 25p.

The advantages and disadvantages of using heavy water in power reactors are discussed. A detailed study of gas- and sodium-cooled heterogeneous heavy water-moderated reactors is presented. This study is concerned with the attainable reactor unit output and with the specific inventory of heavy water. The reactors are described, and the characteristics, steam cycles, fuel, etc., are discussed. (W.D.M.)

8274 AECU-3985
Duquesne Light Co., Shippingport, Penna.
PERIODIC RADIATION SURVEY OF REACTOR PLANT CONTAINER AND COMPONENTS AFTER SHUTDOWN, "C" SURVEY. SECTION III. FIRST PERFORMANCE. Test Results DL-S-184 (T-612076). First Issue, Dec. 18, 1958. 8p. $1.80(ph), $1.80(mf) OTS.

The determination of the changes in radiation level in the hairpin loops resulting from continued operation of the reactor at power were studied. The results indicate that the radiation level in the hairpin loop resulting from continued operation of the reactor at power decays to a relatively low level approximately 20 minutes after isolation of the loop. (auth)

8275 AECU-3987
Duquesne Light Co., Shippingport, Penna.
DETERMINATION OF THE CHEMICAL CHARACTERISTICS OF THE 1B BOILER. SECTION I. Test Results DL-S-209. First Issue, Jan. 13, 1959. 35p. $6.30(ph), $3.00(mf) OTS.

The chemical characteristics of the 1B boiler under variable load conditions were determined in order to ascertain what factors might have contributed to the heat exchanger tube failures. Chemical tests performed on the 1B boiler indicated that boiler water concentrations differed appreciably at various locations within the unit under high load conditions. Discrepancies were noted in the chemical concentrations in samples collected from two neighboring regions in the heat exchanger. The significance of the results was not evaluated since some question existed as to the reliability of the sampling technique. (auth)

8276 AECU-3997
Duquesne Light Co., Shippingport, Penna.
DETERMINATION OF CHEMICAL CHARACTERISTICS OF THE 1B BOILER. SECTION II. Test Results DL-S-209. First Issue, Jan. 15, 1959. 6p. $1.80(ph), $1.80(mf) OTS.

The extent of mixing when chemicals are added to an idle boiler was determined. The chemicals added to the 1B boiler in a hot, idle condition did not become evident in any of three sampling locations tested within a period of two hours after the chemical injection. It is concluded that circulation in idle boilers is inadequate to promote the mixing necessary to distribute chemicals throughout the unit in a two hour period. (auth)

8277 APAE-30
Alco Products, Inc., Schenectady, N. Y.
ARMY PACKAGE POWER REACTOR APPR-1 OPERATING MANUAL AND INSPECTION AND SERVICE MANUAL. Feb. 1958. 388p. $5.00(OTS).

Included in this manual are the component description and operation, safety instructions and precautions, plant operation, and check system for the Army Package Power Reactor. (W.L.H.)

8278 BAW-1044(Rev. I)
Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.
NUCLEAR MERCHANT SHIP REACTOR PROJECT STATUS REPORT ON REACTOR SAFEGUARDS ANALYSIS. May 9, 1958. 189p. $36.30(ph), $10.20(mf) OTS.

With this are bound, appendixes (A): General Electric Co. Atomic Power Equipment Dept. HYDRAULIC SYSTEM DESCRIPTION. (B): Division of Reactor Development. Maritime Reactors Branch, AEC. INDEMNIFICATION AND MARINE INSURANCE FOR NUCLEAR SHIPS. (C): Weather Bureau. METEROLOGICAL ESTIMATES FOR PHILADELPHIA, PENNSYLVANIA-CAMDEN, NEW JERSEY AREA.

The nuclear power plant for the N. S. Savannah and the program in progress for the analysis of potential hazards associated with the operation of a nuclear merchant vessel are described. Particular emphasis is given to the safety features embodied both in the design and operation of the plant. Through subsequent revisions it is

intended that this report ultimately will serve as a Final Reactor Safeguards Report. (W.D.M.)

8279 BAW-1114

Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.

NMSR FISSION PRODUCT AND NEUTRON ACTIVATION DOSE RATES. M. A. Turner. July 1958. 43p. Contract AT(30-3)-274. $7.80(ph), $3.30(mf) OTS.

Calculation techniques and results are described for fission product volumetric source strengths in the core and resulting radiation levels outside the primary shield tank, at the top of the open water-filled pressure vessel, and external to shielded fuel elements removed from the core. A similar analysis is included for neutron activation of reactor internals, pressure vessel, and primary shield tank steel. A Co^{59} concentration of 0.585 wt. % was used to obtain maximum levels. (W.D.M.)

8280 BMI-1236

Battelle Memorial Inst., Columbus, Ohio.

A SIMULATION STUDY OF A REFLECTOR CONTROL SYSTEM FOR A HETEROGENEOUS BOILING REACTOR. Benjamin B. Gordon, J. James Stone, Jr., and Roger S. Boyd. Nov. 14, 1957. 26p. Contract W-7405-eng-92. $4.80(ph), $2.70(mf) OTS.

The feasibility of using a reflector control system for a heterogeneous boiling reactor through use of analog simulation techniques was examined. The reactor kinetics, reactivity, and steam generation were simulated electronically while the hydraulic portion of the reflector system was represented by a full-scale physical mock-up. The two portions of the system were coupled together, and an attempt was made to achieve a stable, nonoscillating system. Various configurations of hydraulic coupling between the reflector tank and surge tank were used to produce the desired representation of the frictional forces in the system. A system of baffle plates in the coupling produced the desired damping. With the stable system, the effect of steam-load-demand changes for various values of incremental moderator worth was examined. These studies showed that a reflector control system for this type of reactor is feasible. (auth)

8281 CF-58-10-49

Oak Ridge National Lab., Tenn.

COST COMPARISONS OF CAPITAL INVESTMENT IN VARIOUS NUCLEAR POWER PLANTS FOR CENTRAL STATION APPLICATION. M. Bender and R. D. Stulting. Oct. 14, 1958. 19p. Contract [W-7405-eng-26]. $4.80(ph OTS), $2.70(mf OTS).

The capital costs for a number of power reactors are compared after escalation to equivalent construction dates. It is shown that the most important factor affecting nuclear power plant capital costs is the net capacity of the plant. Steam conditions are shown to have a relatively minor effect on capital costs. (auth)

8282 DP-315

Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.

HEAVY WATER MODERATED POWER REACTORS QUARTERLY PROGRESS REPORT [FOR] MAY, JUNE, AND JULY 1958. L. Isakoff, comp. Sept. 1958. 70p. Contract AT(07-2)-1. $2.00(OTS).

Continued progress is reported on the nuclear, engineering, and materials aspects of several designs of 100-Mwe power reactors that are heavy water moderated and natural uranium fueled. A method, developed from experimental data, is given for predicting the resonance escape probability of almost any natural lattice in heavy water. The start of firm design for the high temperature irradiation facility, the HWCTR, is reported. Also reported is the continued low temperature irradiation of uranium metal fuels. The results of the fabrication of several additional fuel tubes of U–2 wt. % Zr clad with Zircaloy-2 are presented. Further results are given in the development of a cold-swaging process for the manufacture of low cost fuel elements of natural uranium oxide. (For preceding period see DP-295.) (auth)

8283 MND-E-2004

Martin Co. Nuclear Div., Baltimore.

ERDL-NPFO—QUARTERLY PROGRESS REPORT NO. 6 [FOR] OCTOBER THROUGH DECEMBER 1958. 69p. Contract DA-44-009-ENG-3318.

Autoclave tests of type 430 stainless steel were conducted. Corrosion testing of heat exchangers is discussed. In the nucleate boiling program recorded outputs of ½ and 1 inch were observed with the void detector for 3 and 5% voids, respectively. A transient test at the SPERT facility with the APPR-ZPE core resulted in a peak power of 110 Mw on a period of 5 msec, for a total energy release under the burst of 16.5 Mw-sec. Maximum fuel plate surface temperature was 487°C, and some buckling and blistering were observed. Critical experiments on the 45-element core are described. In the core extrapolation experiments an excursion analysis was completed for the most reactive of the nine cores. (For preceding period see MND-E-2003.) (W.D.M.)

8284 NAA-SR-2796

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

FORCED CONVECTION HEAT TRANSFER CHARACTERISTICS OF POLYPHENYL REACTOR COOLANTS. M. Silberberg and D. A. Huber. Jan. 15, 1959. 43p. Contract AT-11-1-GEN-8. $1.25(OTS).

In support of the Organic Moderated Reactor Experiment, forced-convection heat transfer characteristics of several polyphenyls have been investigated in a laboratory heat transfer loop. Heat transfer runs were made with diphenyl, Santowax R (commercial mixture of terphenyl isomers), and a 2:1 mixture of Santowax O (commercial ortho-terphenyl) and Santowax M (commercial meta-terphenyl). The operating conditions were as follows: fluid temperatures, 480 to 770°F; heater surface temperatures, 565 to 875°F; fluid velocities, 5 to 25 ft/sec; heat fluxes, 40,000 to 290,000 Btu/hr-ft^2; and Reynolds number, 20,000 to 300,000. Experimental heat transfer coefficients obtained at the above conditions ranged from 340 to 2740 Btu/hr-ft^2–°F. The data obtained during this study were correlated by the relationship $Nu = 0.015Re^{0.85}Pr^{0.3}$. No heat transfer surface fouling, with Santowax R and Santowax O-M as test fluids, was observed after extended runs at the following extreme conditions: fluid velocities: 5.5, 10, 15 ft/sec maximum heat transfer surface temperature: 985°F. (auth)

8285 NDA-14-178

Nuclear Development Corp. of America, White Plains, N. Y.

FLAT-SLAB FREEZING PROCESSES WITH RADIOACTIVE MATERIALS HAVING INTERNAL HEAT GENERATION. H. G. Elrod, Jr. July 1, 1957. 32p. $6.30(ph), $3.00(mf) OTS.

An analysis is presented for the case of a flat slab of material suddenly exposed on both sides to a pool of

liquid metal. Results were obtained when radioactivity was present and when it was absent from the liquid metal. The analysis is applied to the axial blanket design of APDA reactor, and the times required after first solid-liquid contact for bridging between adjacent pins and for complete freezing are shown. (J.R.D.)

8286 NDA-14-181

Nuclear Development Corp. of America, White Plains, N. Y.

FREEZING AND REMELTING OF RADIOACTIVE MATERIAL ON COLD, VERTICAL PINS. H. G. Elrod, Jr. July 1, 1957. 24p. $4.80(ph), $2.70(mf) OTS.

If, in some unforeseeable manner, the APDA reactor should instantaneously lose all its coolant, a slow meltdown would occur. Molten fuel from the core would freeze upon encountering the colder pins of the lower axial blanket. A description of the kinetics of such a freezing process is presented. Generalized curves are presented, permitting rapid estimates of the time and extent of freezing for various pin configurations and rates of decay heat generation. For the blanket design described in APDA-115, it is estimated that bridging between adjacent pins would occur in no more than 0.17 sec and complete plugging in no more than 0.57 sec. (auth)

8287 NDA-84-13

Nuclear Development Corp. of America, White Plains, N. Y.

SDR PROJECT QUARTERLY TECHNICAL PROGRESS REPORT NO. 6 FOR THE PERIOD AUGUST 1, 1958 THROUGH OCTOBER 31, 1958. Dec. 31, 1958. 61p. Contract AT(30-3)-256. $9.30(ph OTS), $3.60(mf OTS).

A family of 200-Mw(e) SDR's was designed which could be operable in 1965. They give total energy costs in the range 10 to 12 mills/kwh. The most promising of these reactors has the following characteristics: single-region design, moderate steam conditions, natural uranium fuel, Zircaloy cladding, and stainless steel fuel tubes. A study of the applicability of SDR's to a broad range of power outputs (10 to 500 Mw(e)) was made. Although it appears reasonable to design a natural-uranium SDR with a power output down to 10 Mw(e), present studies indicate significant and wide economic interest at 40 Mw(e) and higher. Difficulties were encountered in interpreting the results of natural uranium–D_2O lattice experiments in the Process Development Pile, and studies were initiated to determine the sources of difficulty and corrective measures. A code, called PALINDROME, which solves the Boltzmann transport equation in the P_3 approximation, was written. Work during the quarter on the Chugach 10-Mw(e) reactor was mainly concerned with completing the layout design of the more important reactor components and systems. A listing of the current design data is given, and a cross section of the reactor is shown. Two major changes were made during the quarter: (1) the substitution of steel ball-filled organic-cooled neutron shield disks for the original concrete-filled, water-cooled designs and (2) the reduction in size of the shutdown gas cooling systems. The preliminary safety analysis is briefly outlined. The development of maintenance techniques is discussed. Approximately 280 additional hours of operation of the SDR mockup facility were logged during the quarter. Modifications were made of the barrier test apparatus, and three successful experiments were performed on 6061 Al alloy. A liquid sodium leak detector was constructed, and also a rig for testing fuel–coolant tube closures. Sodium–liquid water and sodium–water vapor reactions were studied. (For preceding period see NDA-84-12.) (L.T.W.)

8288 NP-6974 and Add.

Brussels. Centre d'Étude de l'Énergie Nucléaire.

BR-2: THE MAXIMUM CREDIBLE ACCIDENT. PROCEDURE AND CONSEQUENCES. H. Dopchie, J. Juliens, and L. Vandewiele. Apr. 1958. 65p. ADDENDUM. June 27, 1958. 10p.

This report and addendum were issued separately, but are cataloged as a unit.

Calculations were made based on extremely conservative assumptions including the dispersion of all volatile fission products in the building, the complete burning of 670 lb of sodium, extreme weather conditions, and the possibility that somebody may remain for an hour in the axis of the very narrow plume leaking out of the building. Despite these pessimistic characteristics, it is felt that on maximum permissible dose could occur outside the C. E. N. site. (W.D.M.)

8289 NYO-8753(Vol. I)

Sanderson and Porter, New York and Alco Products, Inc., [Schenectady, N. Y.].

DESIGN AND FEASIBILITY STUDY OF A PEBBLE BED REACTOR-STEAM POWER PLANT. May 1, 1958. 290p. Contract AT(30-1)-2095. $5.00(OTS).

Originally issued as S and P 1963A, Parts I and II.

A design and feasibility study of a pebble bed reactor-steam power plant is presented. The reactor design which evolved from this study is a 125 Mwe helium-cooled two-region thermal breeder, operating on the uranium-thorium cycle, in which all core structural materials are graphite. Fuel is in the form of unclad spherical elements of graphite, containing fissile and fertile material. The primary loop consists of the reactor plus three steam generators and blowers in parallel. Nuclear characteristics, costs, etc., are given. (W.D.M.)

8290 ORNL-1943

Oak Ridge National Lab., Tenn.

HOMOGENEOUS REACTOR PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JULY 31, 1955. H. F. McDuffie and D. C. Kelly, comps. Aug. 9, 1955. Decl. June 3, 1957. 261p. Contract W-7405-eng-26. $41.40(ph), $11.10(mf) OTS.

Homogeneous Reactor Test. The status of construction of the HRT is summarized. The design of some reactor components is described, including fuel system line coolers, the thermal shield, instrument cubicles, the reactor cell air monitor, and sampling facilities. The important design specifications for the HRT fission-product adsorption system are outlined. The effects of fluid circulation on HRT stability, the results of the rupture of the fuel inlet nozzle on the pressure vessel, core tank temperature, and heat generation and temperature distribution in the control room area shield were examined. Operation of the HRT mockup loop is summarized. High generalized corrosion rates and U precipitation were observed when 50 ppm oxygen was used. Results from tests of HRT pumps, heat exchanger, sampler mockup, and reflex condenser and recombiner are presented. Design of the instrumentation in the control room area and fabrication of differential pressure and liquid level transmitters are reported. Thorium Breeder Reactor. Stability criteria, the effect of slurry settling on reactivity, and neutron losses due to coating the core tank with platinum have

been analyzed for the TBR. An economic study of partial fuel costs for one-region Pu-U reactors was completed. The design concept of a 300-electrical-Mw thorium breeder power station utilizing low-pressure gas recombination was completed, and construction and operating costs were estimated. Design problems which must be solved before the design can be considered practical are discussed. Modification of TBR design from low- to high-pressure recombination was started. Corrosion. Operation of dynamic-corrosion test loops with uranyl sulfate solutions and thorium oxide slurries proceeded in a routine manner, and results are presented tabularly. Sedimentation characteristics of thorium dioxide slurries were determined at 100 to 300°C. Development, fabrication, and operation of in-side loops for radiation corrosion studies are described. Data from in-side loop and bomb experiments to study the corrosion of Zircaloy-2 and stainless steel under irradiation are reported. Results are presented from laboratory corrosion studies of stressed and unstressed specimens of stainless steel, titanium alloy and Zircaloy-2, and unstressed specimens of aluminum oxide in simulated HRT solutions. The effects of sulfate additions, calcination temperature, and particle size on the corrosive effects of thorium oxide slurries were studied. Engineering Development. The status of the heat exchanger development program is summarized. Thorium oxide slurry circulation studies and the development of blanket-system components such as dump tanks and pressurizer are continuing. The power removal capabilities of boiling homogeneous reactors are being studied. The results of stress-corrosion tests on austenitic stainless steels and dynamic-corrosion tests of stainless steel welds are reported. The mechanical properties of irradiated Zircaloy-2, stainless steel, and carbon steel specimens are being studied. Chemical Engineering Development. Studies to determine the effect of irradiation on the properties of thorium oxide slurries and to demonstrate slurry radiation stability were continued. Silver was shown to be a good internal catalyst for the recombination of radiolytic gases in thorium oxide slurries. Progress was made in the characterization of thorium oxide products and slurries by x-ray, nitrogen adsorption surface area, thermogravimetric, and gaseous adsorption techniques, sedimentation particle size analyses, and bulk density measurements. The HRT fuel processing plant is described. The precipitation of neodymium sulfate from fuel solutions is being studied. The behavior of fission- and corrosion-product solids in circulating fuel solutions is being investigated in loops operating at HRT temperatures and pressures. Design studies of the hydroclone were completed, and recommended dimensions are presented. Results of hydroclone corrosion studies and D_2O recovery evaporator studies are reported. Work on plutonium–producer blanket processing included experiments on Pu adsorption on metals, separation of PuO_2 with a hydroclone, and irradiation of uranyl sulfate solutions to determine Pu and Np behavior. Removal of Pu and U from a ThO_2 slurry by leaching is being investigated in connection with processing the blanket of the TBR. Supporting Chemical Research. Preliminary results are reported from phase studies of alkaline carbonate–uranium trioxide systems to determine their potentialities as suitable aqueous homogeneous reactor fuels. Data are presented from studies of three- and four-component UO_3–SO_3–H_2O systems. The adsorption of water on one sample of deaerated ThO_2 has been measured. Study of adsorption by inorganic materials from the point of view of ion exchange was continued. Results of radiation studies on thorium nitrate solutions are reported. (For preceding period see ORNL-1895.) (J.R.D.)

8291 ORNL-2626
Oak Ridge National Lab., Tenn.
MOLTEN-SALT REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING OCTOBER 31, 1958. 129p. Contract W-7405-eng-26. $2.50 (OTS).

Reactor Design Studies. Further studies of the Interim Design Reactor have resulted in an improved fill-and-drain system and alternate ways of transferring heat from reactor fuel to steam. A simplified fuel-to-steam heat transfer is being considered that eliminates intermediate heat transfer fluids. Nuclear calculations relative to a 30-Mw experimental reactor are presented. Calculations of the initial states of U^{233}-fueled reactors were completed. Calculations were also made of the fissions in the blanket of the Interim Design Reactor. Gamma-ray energy absorption coefficients were computed as a function of energy for 24 elements. Development tests of salt-lubricated pump bearings were continued. A conventional Al bearing and an Inconel journal bearing that had been lubricated with Dowtherm "A" during 3200 hr of operation at 1200°F were examined. Materials required for a motor suitable for long term operation at 1250°F in a radiation field are being investigated. A small, submerged, centrifugal pump with a frozen-lead seal is being operated in evaluation tests. Freeze-flange and indented-seal-flange joints that had sealed successfully in high-temperature molten-salt lines were tested with Na. Heater and insulation units designed for use on a 4-inch line were tested along with the large freeze flange. Three commercially available expansion joints were tested and found to be satisfactory for use in molten salt or Na lines. The enthalpies, heat capacities, and heats of fusion were determined for the mixtures $NaF–BeF_2–UF_4$, $LiF–BeF_2–UF_4$, $NaCl–CaCl_2$, and $LiCl–KCl$. Graphite-moderated molten-salt reactors fueled with low-enrichment material were studied, and the results of preliminary calculations indicated that initial enrichments as low as 1.25% U^{235} might be used in a circulating-fuel system. A simplified natural-convection molten-salt reactor for operation at 576 Mw (thermal) was studied to determine the approximate size of components and the fuel volume. Materials Studies. Two Inconel and four INOR-8 thermal-convection loops, which circulated various fused-fluoride-salt mixtures, were examined. Test results were also obtained for three Inconel forced-circulation loops operated with fluoride mixtures. INOR-8 samples removed from forced-circulation loop were found to have no evidence of surface attack. A sodium-graphite system was used to prepare Inconel and INOR-8 tensile specimens for a study of the effect of carburization on the mechanical properties. Corrosion tests of pure Ag and Ag-base brazing alloys in static fuel 130 showed Ag and its alloys to have very limited corrosion resistance. Phase equilibrium studies of fluoride-salt systems containing UF_4 and or ThF_4 were continued. Extensive gradient-quenching experiments were completed on the $LiF–BeF–ThF_4$ system. The effects of divalent and trivalent fission-product ions on the solubility of PuF_3 in $LiF–BeF_2$ mixtures were studied. Solubility studies were

made on several systems, including argon in $LiF-BeF_2$, HF in $LiF-BeF_2$, CeF_3 in $NaF-LiF-BeF_2$, and CeF_3, LaF_3, and SmF_3 in $LiF-BeF_2-UF_4$. Two methods of separating U from undesirable fission products in fluoride-salt fuel solvents are being studied. Tentative values were obtained for the activities and activity coefficients of Ni metal in Ni–Mo alloys. Apparatus was set up for measuring the surface tensions of BeF_2 mixtures. Further measurements of the activity coefficients of CrF_2 dissolved in the molten mixture $NaF-ZrF_4$ were determined and equilibrium quotients were calculated. Studies of Cr diffusion in Cr-containing Ni-base alloys were continued. An experimental study was made of the corrosion of Inconel by $AlCl_3$ vapor in an all-metal system. Tests on the penetration of graphite by molten salts were performed. A new method of preparing chromous fluoride was explored in which the reaction is $SnF_2 + Cr \rightarrow CrF_2 + Sn$. Sufficient laboratory work has been done to confirm that fluorination of the fuel salts $LiF-BeF_2-UF_4$ or $LiF-BeF_2-UF_4-ThF_4$ results in good U recovery. (For preceding period see ORNL-2551.) (W.L.H.)

8292 ORNL-2654

Oak Ridge National Lab., Tenn.

HOMOGENEOUS REACTOR PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING OCTOBER 31, 1958. Feb. 24, 1959. 261p. Contract W-7405-eng-26. $4.00(OTS).

Homogeneous Reactor Test. Power run 17 to study U loss vs. power and power excursions is described. Remote operations following run 17 included corrosion specimen retrieval and viewing the core tank hole. The composition of solids removed by the hydroclone in run 17 is discussed, and other processing plant experience is reported. Power excursions and oscillations observed during HRT operations were analyzed. Other reactor analyses were concerned with the reactivity associated with movement of fluid from one reactor position to another, time behavior following reactivity additions, the critical effect of U deposited on the core-tank wall, the effect of the core corrosion-sample assembly on thermal flux distribution, and the nuclear characteristics versus different core and blanket temperatures. Design work on the replacement pressure vessel is discussed. Other work on component development and controls and instrumentation is reported. Reactor Design, Research, and Analysis. Design studies for HRE-4, now complete, are summarized. Studies of nuclear parameters of single-region slurry reactors were extended to include moderator mixtures of light and heavy water. Reactivity effects of slurry settling were calculated for one-region reactors and for moderator-reflected reactors. The nuclear characteristics of reflected slurry reactors were obtained. Conditions were examined under which storage of thoria–water slurries would be "eversafe." Pressure and thermal stresses in bare spherical reactors were calculated for reactors operating at 2000 psi and 280°C and with diameters 3 to $4\frac{1}{2}$ ft, Th concentration 0 to 400 g/l and with H_2O or D_2O as moderator. The age of fission neutrons in D_2O-H_2O was correlated in terms of an age-diffusion model. Two-group nuclear constants for $ThO_2-H_2O-D_2O$ slurries at 20, 100, and 200°C were prepared. Pressure-drop data for flow of non-Newtonian ThO_2-H_2O in tubes was analyzed. Thoria caking factors were investigated in some 30 gpm loop runs. A number of machine programs were written. Engineering Development. Development of fuel- and slurry- system components continued. Results of slurry circulation runs in the 100- and 200-gpm loops are reported and discussed. Instrument and valve development continued. Reactor Materials Research. The stability of simulated HRT solution in a Zircaloy-2 bypass of a Ti loop was studied. The rate of oxidation of Cr^{3+} to Cr^{6+} in a Ru-containing UO_2SO_4 solution was measured at 225, 250, and 275°C. The effect of cold work and heat treatment on corrosion resistance of type 347 stainless steel was investigated. Phosphate and fluoride ions partially inhibited stress-corrosion cracking of 347 stainless steel in chloride-containing water at 200°C. The effect of UO_2^{2+} on stress-corrosion cracking of 347 stainless steel in chloride-containing UO_2SO_4 solutions was studied. Various treatments to prevent cracking of wrought type-347 stainless steel U-bend specimens in chloride- and oxygen-containing water at 300°C were tried. Cast 347 stainless steel shows no susceptibility to cracking in boiling 42% $MgCl_2$ or high-temperature chloride-containing water. Corrosion of type-347 stainless steel and Zircaloy-2 U-bend specimens by oxygenated ThO_2 slurries containing 100 ppm chloride at 300°C was studied. Tests with a Luminol solution were run to study chemiluminescence for detection of defects inside vessels. Corrosion tests of CD4MCu stainless steel and Multimet in high-temperature UO_2SO_4 solution are reported. Dynamic slurry corrosion data from loop runs with 1600°-calcined ThO_2 are reported for an austenitic stainless steel loop, Ti circulating pumps, specimens of austenitic, ferritic, and martensitic stainless steels, Incoloy, and Nionel. Thoria prepared by draft-tube precipitation were circulated to study the response of various metals. Thoria microcubes were circulated in oxygen and in hydrogen atmospheres to study metal corrosion. Rocking autoclave experiments in LITR with a Zircaloy-2 autoclave containing ThO_2-UO_2 slurry are described. An in-pile slurry toroid rotator was tested. A sintered-metal filter was tested in the 5 gpm in-pile slurry loop. Radiation corrosion experiments with uranyl sulfate solutions on stainless steel, Zircaloy-2, Zr alloys, and Ti-110AT are reported and discussed. Corrosion specimens from the blanket region of HRT runs 13 and 14 were examined. The corrosion of a 347 stainless steel flange and specimen during runs 15 and 16 was studied. In-pile rocking-autoclave corrosion experiments are reported. Adsorption of U from UO_2SO_4 solutions on hydrous ZrO_2 at high temperatures was studied. Metallurgy studies are reported on: effect of fabrication variables on machanical anisotropy of Zircaloy-2 plate; the $\alpha/\alpha+\beta$ temperature of Zircaloy-2, and its resistivity during β-formation; chemical machining and pickling of Zircaloy-2; H and D content of Zr alloy exposed to $D_2O-UO_2SO_4$ solutions; welding Ti pipe; filler metal for welding Ti and Zr; welding Zr and Nb–Zr in air; attenuation of ultrasound in stainless steel weld metal; and radiation-induced transition-temperature increase in Fe and Fe–0.1% C. Chemical Engineering Development. Behavior of iodine in UO_2SO_4 fuel processing was studied. Performance of a hydroclone in removing solids from a corrosion loop was studied. Study of burning of the charcoal beds continued. ThO_2 slurry development continued, and work on the in-pile slurry loop continued. Supporting Chemical Research. Studies of the homogeneous catalysis of the H_2-O_2 reaction by Cu salts in aqueous solutions at high temperatures continued. Experiments to test hypotheses as to the disappearance of U and Cu from HRT fuel solution

runs were performed. Analytical Chemistry. Methods were devised for determining U in Sn, chloride in UO_2SO_4, and Fe in UO_2SO_4. (For preceding period see ORNL-2561.) (T.R.H.)

8293 TID-5301(Del.)
Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif.
KAISER ENGINEERS NUCLEAR POWER STUDY. PRELIMINARY DESIGN OF A BOILING HEAVY WATER POWER REACTOR. Job No. 5473. Patrick J. Selak, Joseph Finke, George B. Humphreys, Alexander L. Lindsay, Jr., and Thomas E. Stephens. Nov. 29, 1955. Decl. with deletions Feb. 28, 1957. 121p. (KENPS-55-86-R(Del.)). $19.80(ph OTS); $6.30(mf OTS).

A preliminary design of a boiling heavy water heterogeneous reactor is presented. It is estimated that the 100 Mwe reactor could be built for $300 per kw and would be capable of producing power at a cost of about 10 mills/kwh. Slight enrichment is provided for, although the reactor can operate on natural fuel with only a small sacrifice in power density. The amount of D_2O operating inventory required outside the reactor vessel is estimated to be about 15% of the total D_2O in the system. (W.D.M.)

8294 TID-7563
Atomic Energy Commission, Washington, D. C. and Maritime Administration, Washington, D. C.
PROCEEDINGS OF THE 1958 NUCLEAR MERCHANT SHIP SYMPOSIUM, HELD IN WASHINGTON, D. C., AUGUST 21, 1958. 203p. $2.50(OTS).

The objectives of the second symposium on the application of nuclear power to merchant ship propulsion were to acquaint shipping officials with the state of the art of nuclear propulsion for ships, to explore and discuss operational problems of nuclear-powered merchant ships in foreign commerce, to gain the benefit of the views of merchant marine industry officials, and discuss the outlook for nuclear propulsion to meet the specific requirements of the industry. Reports on the construction of the N. S. Savannah, the design of a nuclear tanker, maritime reactor propulsion systems, and economic comparisons were presented. (W.D.M.)

8295 TID-7563(p.11-32)
Babcock and Wilcox Co. Atomic Energy Div., [Lynchburg, Va.].
THE POWER PLANT FOR THE FIRST NUCLEAR MERCHANT SHIP (N.S. SAVANNAH). John W. Landis. p.11-32 [of] PROCEEDINGS OF THE 1958 NUCLEAR MERCHANT SHIP SYMPOSIUM, HELD IN WASHINGTON, D. C., AUGUST 21, 1958. 22p.

Final design and fabrication of the power plant for the first nuclear ship, the N. S. Savannah, is proceeding in accordance with the accelerated schedules laid down at the outset of the contract. Plant location, layout, and performance data are given. The reactor system is discussed in terms of its design and performance characteristics. Other topics discussed include the propulsion system, waste disposal, and safety. (W.D.M.)

8296 TID-7563(p.33-43)
American-Standard. Atomic Energy Div., [Mountain View, Calif.].
ECONOMICS OF NUCLEAR AND CONVENTIONAL MERCHANT SHIPS. David L. Conklin et al. p.33-43 [of] PROCEEDINGS OF THE 1958 NUCLEAR MERCHANT SHIP SYMPOSIUM, HELD IN WASHINGTON, D. C., AUGUST 21, 1958. 11p.

In view of the probable economic potential of nuclear-powered ships, a basis for the requirements for competitive maritime nuclear power was developed and the possible specific ship and reactor combinations which meet these requirements were evaluated. In comparing nuclear power plants with one another and with conventional plants, entire ship, power plant, and trade route combinations were evaluated. (W.D.M.)

8297 TID-7563(p.44-55)
Stanford Research Inst., Menlo Park, Calif.
ECONOMIC ANALYSIS OF CONVENTIONAL SHIPS. Robert K. Arnold and Charles A. Jackson. p.44-55 [of] PROCEEDINGS OF THE 1958 NUCLEAR MERCHANT SHIP SYMPOSIUM, HELD IN WASHINGTON, D. C., AUGUST 21, 1958. 12p.

The capital and operating costs of the 1957 conventional vessels in the five ship families are estimated for 1957, 1965, and 1970. The present and expected future demand for and supply of conventionally powered tankers engaged in movements of petroleum and petroleum products was studied as an example of the type of analysis required of basic supply and demand conditions. (W.D.M.)

8298 TID-7563(p.56-62)
American-Standard. Atomic Energy Div., [Mountain View, Calif.].
COMPARATIVE ECONOMICS OF NUCLEAR AND CONVENTIONAL SHIPS. Jack J. Gordon. p.56-62 [of] PROCEEDINGS OF THE 1958 NUCLEAR MERCHANT SHIP SYMPOSIUM, HELD IN WASHINGTON, D. C., AUGUST 21, 1958. 7p.

Some of the changes occasioned by the shift from conventional to nuclear power appear as differences in capital and operating costs. A considerable portion of the net cost difference is in fixed costs. The most significant of these fixed costs in a comparison between nuclear and conventional ships are, in order of their importance, amortization, wages, insurance, and fuel inventory. Variable fuel costs and potential cost reductions are discussed. (W.D.M.)

8299 TID-7563(p.66-77)
Matson Navigation Co., San Francisco.
CONVENTIONAL SHIP DESIGN. L. A. Harlander. p.66-77 [of] PROCEEDINGS OF THE 1958 NUCLEAR MERCHANT SHIP SYMPOSIUM, HELD IN WASHINGTON, D. C., AUGUST 21, 1958. 12p.

In accordance with the philosophy that trends in ship design will be based solely on economic conditions, design is described in such a manner that the costs can be determined after trade-route conditions are known. There are three basic ship characteristics which reflect construction and operating costs, and which must be known before the multiplicity of characteristics and components can be determined in a design to yield the most profitable ship. These three basic characteristics are description of cargo to be carried, size, and speed. (W.D.M.)

8300 TID-7563(p.78-95)
Todd Shipyards Corp., San Francisco and American-Standard. Atomic Energy Div., [Mountain View, Calif.].
NUCLEAR SHIP DESIGN. Benjamin W. Winchell and Jack J. Gordon. p.78-95 [of] PROCEEDINGS OF THE

1958 NUCLEAR MERCHANT SHIP SYMPOSIUM, HELD IN WASHINGTON, D. C., AUGUST 21, 1958. 18p.

Substitution of nuclear power for conventional power in merchant ship propulsion causes changes in some of the factors involved in design and operation. These changes are reflected in the subsequent economic analysis, affecting both earning capacity and operating costs. Weight and space adjustments are discussed, and various power cycles are evaluated including boiling water, pressurized water, organic moderated, and gas cooled. (W.D.M.)

8301 TID-7563(p.96-108)
American-Standard. Atomic Energy Div., [Mountain View, Calif.].
REACTOR SYSTEMS AND COMPARISONS. David L. Conklin. p.96-108 [of] PROCEEDINGS OF THE 1958 NUCLEAR MERCHANT SHIP SYMPOSIUM, HELD IN WASHINGTON, D. C., AUGUST 21, 1958. 13p.

Comparisons between systems, cost estimation techniques in general, and areas of potential cost reduction are discussed. The four reactor systems analyzed, PWR, BWR, GCR, and OMR, are shown with shielding and containment vessel arrangements installed aboard ship. The basic design philosophy employed for all of the reactors is the same except for the organic-moderated reactor. (W.D.M.)

8302 TID-7563(p.109-17)
American-Standard. Atomic Energy Div., [Mountain View, Calif.].
CALCULATIONAL METHODS. Mark I. Temme. p.109-17 [of] PROCEEDINGS OF THE 1958 NUCLEAR MERCHANT SHIP SYMPOSIUM, HELD IN WASHINGTON, D. C., AUGUST 21, 1958. 9p.

The two measures of effectiveness by which ships are compared are the cost per unit of cargo carried and the relative revenue required to earn a stated return on the original investment. The computational method which accomplishes this comparison places a ship on a hypothetical trade route, starts it circling and making port calls, and at the end of a year's operation totals the cost of operation and the amount of cargo transported. (W.D.M.)

8303 TID-7563(p.118-33)
Sharp (George G.) Inc., New York.
SOME DEVELOPMENTS IN THE ECONOMIC APPLICATION OF NUCLEAR POWER TO MERCHANT SHIPS. Douglas C. MacMillan. p.118-33 [of] PROCEEDINGS OF THE 1958 NUCLEAR MERCHANT SHIP SYMPOSIUM, HELD IN WASHINGTON, D. C., AUGUST 21, 1958. 16p.

Considerable study has been devoted to the economics of nuclear propulsion. The initial studies have considered the application of a boiling water type reactor to the propulsion of the T5-S-RM2a tanker. Comparisons of a number of cycles using this reactor were made and indicated that the maximum advantages and the greatest progress would be attained by proceeding with a design using a natural circulation type reactor with a direct cycle. (W.D.M.)

8304 TID-7563(p.134-55)
General Electric Co. Atomic Power Equipment Dept., [San Jose, Calif.].
BOILING WATER REACTOR FOR MERCHANT SHIP PROPULSION. R. L. Schmidt and L. F. Fidrych. p.134-55 [of] PROCEEDINGS OF THE 1958 NUCLEAR MERCHANT SHIP SYMPOSIUM, HELD IN WASHINGTON, D. C., AUGUST 21, 1958. 22p.

A preliminary economic analysis of a possible first large nuclear propelled tanker of 39,000 dead weight tons and incorporating the boiling water reactor propulsion system indicates less than a 10% increase in cost per ton of cargo over a conventional powered ship of the same tonnage. The major features of the proposed propulsion system for the nuclear powered tanker are described. A cost analysis is made of the nuclear and conventional tanker under like conditions. (W.D.M.)

8305 TID-7563(p.156-69)
General Atomic Div., General Dynamics Corp., San Diego, Calif.
GAS-COOLED REACTOR PLANTS FOR MARINE PROPULSION. T. H. Pigford. p.156-69 [of] PROCEEDINGS OF THE 1958 NUCLEAR MERCHANT SHIP SYMPOSIUM, HELD IN WASHINGTON, D. C., AUGUST 21, 1958. 14p.

The technical approach to the development of the Maritime Gas Cooled Reactor prototype is described. The objectives of the MGCR program are an unusually compact plant, low capital, fuel, and operating costs, and operational safety with a minimum requirement of nuclear containment. Component and material selections are discussed. Performance is estimated for the processes chosen for adaptation to the MGCR. (W.D.M.)

8306 TID-7563(p.170-92)
Oak Ridge National Lab., Tenn.
ALTERNATIVE APPROACHES FOR NUCLEAR SHIP PROPULSION. PART I. ADVANCED REACTOR TYPES. J. A. Lane. PART II. A NEW TYPE OF PROPULSION MACHINERY. A. P. Fraas. p.170-92 [of] PROCEEDINGS OF THE 1958 NUCLEAR MERCHANT SHIP SYMPOSIUM, HELD IN WASHINGTON, D. C., AUGUST 21, 1958. 23p.

The results of a survey of alternative reactors for ship propulsion indicate that organic moderated and molten fluoride reactors offer considerable promise of reduced costs. Homogeneous burner reactors, on the other hand, do not appear to have an economic advantage for maritime applications. The nuclear gas engine is a new type of power plant that shows great promise for Marine applications. A preliminary study of the reciprocating engine operating on a gas cycle indicates that an efficiency of 30% is obtainable. (W.D.M.)

8307 TID-7564
Oak Ridge National Lab., Tenn.
INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 376p. $3.50(OTS).

This meeting is one of a series of Civilian Power Reactor Conferences and was held coincident with an AEC invitation to industry to bid on the construction of a gas-cooled facility. Papers are presented on design studies, hazards, components, costs, materials, and design concepts for specific reactors. (W.D.M.)

8308 TID-7564(p.1-12)
Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif.
INTRODUCTION TO THE KE-ACF GAS-COOLED NUCLEAR POWER PLANT. J. S. Ritchie. p.1-12 [of] INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 12p.

The design parameters for the various KE-ACF designs are outlined, and a summary of the design features covered in detail is presented. A description and comparison of the preliminary design parameters and cost estimates are made for two power plants, CO_2–cooled graphite-moderated, one designed for natural uranium and the other designed for approximately 2% enriched uranium. Enrichment permits use of higher-temperature fuel element materials and also allows a smaller core volume. The resulting higher reactor outlet temperature (1000 F compared to 800 F), reactor inlet pressure (400 compared to 285 psia), and average specific power (10.3 compared to 2.4 mw/M.T.), along with higher fuel burnup (10,000 compared to 3,000 mwd/M.T.), account for the lower power cost of 13.6 mills/kwhr for the enriched plant compared to 15.7 for the natural plant. A general description of the projected prototype helium cooled GCPR is given. (auth)

8309 TID-7564(p.13-48)

[Nuclear Products-Erco Div.], ACF Industries, Inc., Washington, D. C. and Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif.

THE METHOD FOR THE OPTIMIZATION OF A HELIUM-COOLED GRAPHITE MODERATED REACTOR POWER PLANT. L. L. Kintner, P. M. Wood, J. T. Jackman, and J. P. Ernst. p.13-48 [of] INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 36p.

The optimum combination of the major design parameters was determined for the large scale helium cooled reactor power plant presently being designed by ACF Industries, Inc. and Kaiser Engineers. The basic parameters of the optimum plant including the outlet gas temperature and maximum specific power become the design basis for the Helium Cooled Prototype GCPR. The purpose of the prototype is to demonstrate the parameters of the optimum plant and to provide engineering, construction, and operating experience applicable to the optimum plant. The method and results of the optimization analysis are given. (auth)

8310 TID-7564(p.49-53)

[Nuclear Products-Erco Div.], ACF Industries, Inc., Washington, D. C.

PHYSICS OF THE PROTOTYPE ENRICHED GCPR. P. M. Wood. p.49-53 [of] INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 5p.

In the physics analysis of the prototype Enriched Gas Cooled Power Reactor the usual calculations of lattice parameters, reactivity lifetime, and control rod worth were made. Some of the results which most affect the operating characteristics of the core are presented. (auth)

8311 TID-7564(p.54-62)

[Nuclear Products-Erco Div.], ACF Industries, Inc., Washington, D. C.

DESIGN BASIS FOR THE PEGCPR FUEL ASSEMBLY. R. S. Miller, S. B. Burwell, J. K. Davidson, and W. J. O'Leary. p.54-62 [of] INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 9p.

The development of ceramic uranium dioxide fuel is discussed. The design limitations and parameters are given. The requirement for containment of fission products within the fuel elements is explained and the design of the container for the fuel element is reviewed. The helium cooled partially enriched uranium dioxide fuel elements and fuel assemblies are described, and the method of estimating their lifetime is presented. (auth)

8312 TID-7564(p.63-9)

[Nuclear Products-Erco Div.], ACF Industries, Inc., Washington, D. C.

REACTOR CORE STRUCTURE OF THE PEGCPR. F. R. Rulien. p.63-9 [of] INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 7p.

The graphite core structure is described, and the bases for the selection of the more important materials are discussed. The operating conditions are given and the effects of these conditions on the design of the core structure are reviewed. (auth)

8313 TID-7564(p.70-7)

[Nuclear Products-Erco Div.], ACF Industries, Inc., Washington, D. C.

REACTOR HAZARDS. P. I. Perry. p.70-7 [of] INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 8p.

The hazards resulting from various assumed accidents and component failures were examined for the prototype, natural uranium and partially enriched uranium gas cooled power reactor systems. In general, the hazards associated with both types of reactors are similar. Both systems are characterized by large core heat capacities and relatively slow control rod withdrawal rates. These characteristics combined with the prompt negative temperature coefficient of reactivity of the fuel makes both reactors stable to power and temperature transients. The major difference in the two reactor systems is the presence of the chemically reactive fuel element materials, metallic uranium and Magnox, in the natural uranium system. (auth)

8314 TID-7564(p.78-97)

Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif.

REACTOR PRESSURE VESSEL AND CHARGE MACHINE. H. D. Young. p.78-97 [of] INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 20p.

A comparison is given of the dimensions of the pressure vessels for the nuclear power reactors in service and under construction in the United Kingdom and the vessel designs of KE-ACF. The prominent problems considered in the designs of the KE-ACF pressure vessels are discussed, including the selection of sizes and configurations, nuclear heating, induced radiation, radiation damage, brittle fracture probability, seismic stability, and requirements in addition to those of the ASME Code. The charge machine is described in some detail and its versatility is illustrated by a typical sequence of operations. (auth)

8315 TID-7564(p.98-109)

[Nuclear Products-Erco Div.], ACF Industries, Inc., Washington, D. C.

SERVICE MACHINE AND CONTROL ROD DRIVES. G. W. Fieser. p.98-109 [of] INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 12p.

A description is given of the service machine, in-

cluding its approximate size and operating functions. The control rod drives and their components are discussed. The operations of the entire drive mechanisms are briefly described. (auth)

8316 TID-7564(p.110-18)
Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif.
NON-NUCLEAR MECHANICAL COMPONENTS. J. P. Ernst. p.110-18 [of] INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 9p.

The salient features of the helium prototype reactor coolant and steam systems are described. Criteria for the selection of the various components are discussed, and a brief description is given of the gas purification-vessel cooling system. The basis for selection of the steam cycle is given along with pertinent information on the steam generators, turbine and auxiliaries, and plant control. (auth)

8317 TID-7564(p.119-37)
Oak Ridge National Lab., Tenn.
THE ORNL GAS-COOLED REACTOR DESIGN. A. P. Fraas. p.119-37 [of] INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 19p.

The major features of the ORNL GCR-2, a helium-cooled enriched reactor, are presented. The details of the design and the bases for the major design decisions are contained in ORNL-2500. The major points of similarity and difference between the British designs and the GCR-2 are discussed. It appears that through use of fuel enrichment and helium-cooling it is possible to obtain both lower capital costs and lower power costs. (W.D.M.)

8318 TID-7564(p.138-64)
Oak Ridge National Lab., Tenn.
MATERIALS SELECTIONS AND DEVELOPMENT WORK. W. D. Manly and J. H. Coobs. p.138-64 [of] INFORMATION MEETING ON GAS COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 27p.

The selection of the fuel, fuel capsule, pressure vessel, and related structures for the Oak Ridge National Laboratory gas-cooled reactor (GCR-2) is reviewed. Recent development work in support of the design of the forty-megawatt gas-cooled prototype reactor is discussed, including the development of an improved fabrication process for uranium dioxide fuel pellets and testing of the fuel capsule material. Preliminary results from fuel irradiation tests are presented, and the variables to be studied in the Fuel Capsule Irradiation Program are discussed. (auth)

8319 TID-7564(p.165-84)
Oak Ridge National Lab., Tenn.
MATERIALS COMPATIBILITY AND FUEL ELEMENT TEST PROGRAM. D. B. Trauger. p.165-84 [of] INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 20p.

Metals and alloys of interest as possible materials of construction for a gas-cooled reactor and reactor-grade graphite were heated together in vessels containing static helium or in helium filled natural convection and forced convection loops. From these tests, measures of the inertness of various test specimens to the gaseous impurities evolved from graphite on heating were obtained. The proposed fuel element test program is given. The variables under investigation are discussed. (W.D.M.)

8320 TID-7564(p.185-92)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
GRAPHITE STUDIES FOR THE GAS-COOLED REACTOR PROGRAM. D. E. Baker. p.185-92 [of] INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 8p.

The rate of oxidation of graphite by carbon dioxide depends upon a number of variables which include the graphite temperature, radiation intensity, gas composition, flow rate, and pressure. Physical properties of the graphite which change the extent of surface area available for reaction also affect the rate of oxidation. Coated graphites, inhibitors or impermeable graphites which would limit oxidation to an acceptable value in an advanced gas cooled reactor are needed. A basic program for the study of the reactions of gases with graphite includes thermal reaction studies and irradiation induced reaction studies. An essential facility in the over-all study of gas-graphite reactions is a recirculating gas loop which will allow proof testing of promising materials and will aid in setting limits on the variables that affect the CO_2-graphite reaction. Although coolant graphite reactions are of primary importance, radiation damage to graphite cannot be neglected. Graphite has been observed to expand when irradiated at temperatures below 300°C and to contract at higher irradiation temperatures. The accumulation of stored energy in the cooler regions of reactors and the decrease in graphite strength as a result of oxidation must also be evaluated. (auth)

8321 TID-7564(p.193-215)
Sanderson and Porter, New York.
A HIGH TEMPERATURE-GAS CYCLE PEBBLE BED REACTOR FOR CENTRAL STATION USE. S. T. Robinson and R. F. Benenati. p.193-215 [of] INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 23p.

A high-temperature gas cycle Pebble Bed Reactor is described together with the specific design and economics of a 125 Mwe central station power plant. The nuclear characteristics of the system are presented together with a discussion of fuel cycles, fuel element types, and development problems. (auth)

8322 TID-7564(p.216-33)
General Nuclear Engineering Corp., Dunedin, Fla.
DESIGN CONCEPT FOR A GAS-COOLED, PRESSURE TUBE D_2O-MODERATED REACTOR. G. M. Roy and M. F. Valerino. p.216-33 [of] INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 18p.

The design concept for the East Central Nuclear Group-Florida West Coast Nuclear Group gas-cooled project includes pressure tubes, CO_2 coolant, and D_2O moderator. The attainment of high gas temperature permits the utilization of an efficient steam cycle. Net electrical output of the prototype is to be 50 Mw; of the large scale reactor, 200 Mw. The gas coolant temperature is to be at least 1000°F. (W.D.M.)

8323 TID-7564(p.234-42)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
PARAMETRIC STUDIES OF THE GAS-COOLED REAC-

TOR CONCEPT. Harold W. Heacock. p.234-42 [of] INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 9p.

Generalized parametric studies of the gas-cooled graphite-moderated power reactor concept were performed at Hanford. These studies included consideration of capital charges, fuel cost, and operating expense for a number of process variables. Among the items considered for their effect on unit electrical power cost were the following: coolant gas selection, fuel enrichment, reactor thermal rating, power recovery cycle, coolant outlet temperature and reactor differential temperature, lattice geometry, and specific tube power. Subsequent to the completion of the initial studies, additional parametric studies of the reactor core configuration were performed. In these analyses attention was given to the effects upon relative unit power cost, for the more optimum cases, of the following variables; moderator to fuel ratio, active zone length to core diameter ratio, specific tube power, process channel flow area ratio, and reactor coolant differential temperature. (auth)

8324 TID-7564(p.243-304)
General Atomic Div., General Dynamics Corp., San Diego, Calif.
THE MARINE GAS-COOLED REACTOR PROGRAM. S. A. Bernsen, J. C. Bokros, R. C. Howard, T. H. Pigford, and W. P. Wallace. p.243-304 [of] INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 62p.

The specific objective of the Marine Gas Cooled Reactor Program is to develop, design, build, and test a prototype gas-cooled reactor closed-cycle gas-turbine power plant for maritime application. The interest in the closed-cycle gas-turbine system for the MGCR is explained, and the present status of the program is described. The goal of the system is to provide gas temperatures of 1300°F and higher and fuel element lifetimes in excess of one year. (W.D.M.)

8325 TID-7564(p.305-24)
Bureau of Mines, Morgantown, W. Va.
HIGH-TEMPERATURE SYSTEMS FOR NUCLEAR PROCESS HEAT. James P. McGee. p.305-24 [of] INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 20p.

Investigations are being conducted to determine the feasibility of using nuclear heat in chemical processing. The use of nuclear reactors to furnish high-temperature heat is a field that has not received as much attention as electric power production and propulsion. As part of the Atomic Energy Commission—Bureau of Mines process heat reactor program, a system is being studied in which helium is used as a heat-transfer medium from the nuclear reactor to the chemical processing vessel. A vessel heated by electrical induction to simulate a nuclear fission source of heat has been designed and constructed and is undergoing preliminary testing. Gasification of coal and re-forming of hydrocarbons are promising uses for nuclear process heat. (auth)

8326 TID-7564(p.325-33)
Oak Ridge National Lab., Tenn.
COST AS A DESIGN CRITERION. M. Bender. p.325-33 [of] INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 9p.

The entire approach to the design of nuclear central power stations is founded on the premise of low-cost power production. In this discussion three illustrations of cost considerations in design are presented. These are capacity effects on power station capital costs, geometry effects on fuel element costs, and design standardization effects on nuclear power plant costs. (W.D.M.)

8327 TID-7564(p.334-46)
Oak Ridge National Lab., Tenn.
ADVANCED DESIGN STUDIES. A. M. Perry. p.334-46 [of] INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 13p.

The purpose of advanced design studies, at the present stage of gas-cooled reactor development, is mainly to disclose those combinations of materials and operating parameters that show the greatest promise of yielding low cost electric power or of satisfying some other design criterion such as successful breeding. Preoccupation with the reactor now under development has been such that not a great deal of advanced design work has yet been undertaken. A few rather well defined studies have been carried out: an investigation of the breeding capabilities of graphite-moderated, gas-cooled reactors, a brief study of high-pressure systems, and a nuclear gas engine for maritime applications. (auth)

8328 TID-7564(p.347-62)
Oak Ridge National Lab., Tenn.
RELEASE OF ACTIVITY FROM VARIOUS GCR SYSTEMS. W. B. Cottrell. p.347-62 [of] INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 16p.

There are three different parameters which, as their values are increased in any particular design, tend to make the reactor more hazardous and may make containment necessary. These are operating temperature, power density, and activity in coolant. Some pertinent information relative to hazards considerations for several operating or proposed gas-cooled reactors is listed. Employing a quasitheoretical approach backed by some experimental data, an estimate of the equilibrium amount of various fission product isotopes present in the coolant was made for several fuel element models. (W.D.M.)

8329 TID-7564(p.363-72)
Oak Ridge National Lab., Tenn.
ADVANCED MATERIALS DEVELOPMENT. J. H. Coobs. p.363-72 [of] INFORMATION MEETING ON GAS-COOLED POWER REACTORS, OAK RIDGE NATIONAL LABORATORY, OCTOBER 21-22, 1958. 10p.

The materials problems associated with the design of advanced gas-cooled reactor systems are discussed, and a number of materials combinations are evaluated. Preliminary results of current development work on fuel elements and capsule materials are presented. Three of the most favorable materials combinations are selected and proposed for further study. (auth)

8330 WCAP-910
Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh and Pennsylvania Power and Light Co. Atomic Power Dept., Pittsburgh.
PAR IN-PILE TEST LOOP. Design-Safety and Status

Report. Revision 1. J. Weisman, C. D. Repp, L. O. Ricks, E. E. Wicker, H. K. Search, and J. A. Mayer. Jan. 1959. 136p. Contract W-7405-Eng-26, Subcontract No. 1342. $21.30(ph), $6.90(mf) OTS.

In part A of this report the in-pile loops which PAR was to supply are described in detail. Part B describes the status of the PAR work at the time of termination of the project. All out-of-pile operating experience is presented together with a summary of the design and construction status. Detailed lists of all drawings used for the construction of the loop and equipment racks are provided. (W.L.H.)

8331 YAEC-73

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

MODERATOR TEMPERATURE COEFFICIENT OF THE YANKEE REACTOR AS PRESENTED IN THE YANKEE PRELIMINARY HAZARDS SUMMARY REPORT. H. C. Hecker, Jr., and W. H. Arnold, Jr. Aug. 1958. 22p. For Yankee Atomic Electric Co. Contract AT(30-3)-222, Subcontract No. 1. $4.80(ph OTS); $2.70(mf OTS).

A series of calculations performed to determine the temperature coefficient of the Yankee first core is presented. The effect of control on the core coefficients is not included. (auth)

8332 YAEC-77

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

DEFLECTION AND STRESS ANALYSIS OF THE YANKEE CORE SUPPORT STRUCTURE. Gim H. Eng. Sept. 22, 1958. 54p. For Yankee Atomic Electric Co. Contract AT(30-3)-222, Subcontract No. 1. $1.50(OTS).

The deflection and stresses of a model of the Yankee lower core support structure, consisting of two circular perforated plates joined together by a circular reinforcing rib and 76 cylindrical spacers, were obtained experimentally. The relationships between the tests on the model and reference design were determined by an application of dimensional analysis. Experimental investigations are described in which various design parameters were determined and the structural rigidity of the assembly was obtained. A rational method of semi-theoretical analysis of the problem is suggested based on Reissner's small deflection theory which takes into account the effect of transverse shear and normal stress deformation. (auth)

8333 AEC-tr-3558

ATOMIC ENERGY IN AVIATION. (Atomnaya Energiya v Aviatsii.) Yu. N. Sushkov. Translated by Jan Woroncow (General Electric Co., Cincinnati) from a publication of the Publishing House of "Knowledge," Moscow, 1958. 26p. $4.80(ph), $2.70(mf) JCL or LC.

A review of fundamental reactor principles is presented. Basic reactor types are described along with a general discussion of fuels and their use. In addition, some possible ways of building nuclear aircraft engines are examined, as well as their use and attendant aircraft configurations. The discussions are general and presented in layman's language. (J.R.D.)

8334 CEA-tr-R-487

PROJET D'UNE CENTRALE ELECTRIQUE NUCLEAIRE DE 420 MW DE PUISSANCE. (Project for a Nuclear Power Station of 420 MW Power.) Translated into French by B. Vinogradov from Rapport presente a la Conference Mondiale sur l'Energie. Belgrade 1957 Brochure. 52p.

The essential characteristics of a nuclear power plant being constructed in Russia are described. Reactors with light water under pressure as moderator and coolant and with slightly enriched uranium as fuel will be used in the power plant. The primary capacity will be 420,000 kw/hr in two units. Each unit will consist of one reactor with a capacity of 210,000 kw/hr and three turbines of 70,000 kw each. The power plant will be connected to the general electrical system of the European part of Russia. It is expected to be operating in 1960. (J.S.R.)

8335

PROJECT OF A NUCLEAR HEATING PLANT FOR 30,000 kw THERMAL OUTPUT. A. F. Fritzsche and P. de Haller (Firma Gebruder Sulzer, Winterthur, Switzerland). Atompraxis 4, 451-9(1958). (In German)

A study group for reactor plants formed in 1955 has carried out extensive investigations into power reactors in the past three years with a view to meeting the future demands for power in Switzerland. As a first stage of development towards the realization of a large power station, Sulzer Brothers have collaborated with other firms in the preparation of a preliminary project for a small reactor plant which is briefly described. (auth)

8336

ECONOMY OF HEAT STORAGE PLANTS IN COMBINATION WITH REACTOR POWER STATIONS. Dieter Smidt. Atomwirtschaft 3, 510-11(1958) Dec. (In German)

Atomic power stations require a high load factor because of their high capital cost, otherwise they will not be economical to run. Consequently, their basic load range will be limited and peak loads must to a larger degree be distributed among the other power stations connected to the grid. In certain cases it might be advantageous not to use this undesirable expedient but to balance the load variations by a combination of atomic power station and heat storage. (auth)

8337

BORON FLUORIDE (BF_3) AS COMPRESSIBLE REACTOR CONTROL MEDIUM. Energia es Atomtech. 11, 485-93(1958). (In Hungarian)

Some of the physical and nuclear properties of BF_3 gas which make its use in reactor safety devices attractive are given and discussed. Methods for enriching the B^{10} isotope are also considered. (D.E.B.)

8338

ARGONNE LOW POWER REACTOR. Nuclear Eng. 4, 18-22(1959) Jan.

A detailed discription is given of the Argonne Low Power Reactor core design, fuel elements, control, coolant circuit, enclosure and shielding, and safety. (W.L.H.)

8339

STEPS IN DESIGNING A GAS-COOLED REACTOR. K. J. Wootton (General Electric Co., Ltd.). Nuclear Power 4, 64-73(1959) Feb.

A discussion is presented of the steps used in designing a gas-cooled reactor for a 150 Mw power station. (W.L.H.)

8340

SOME NOTES ON THE STRENGTH OF THE ENRICO FERMI REACTOR VESSEL STRUCTURE. F. R. Beyer (Atomic Power Development Associates, Inc., Detroit). Trans. Am. Soc. Mech. Engrs. Ser. A 81, 66-72(1959) Jan.

The place and function of the reactor vessel in the Enrico Fermi Atomic Power Plant are described. Strain gaging during hydrostatic testing gave limited results. High-temperature strain gages will be used during simulated-service tests prior to start-up. A successful high-temperature strain-gaging technique for long-time static applications up to at least 900°F is developed and described. (W.L.H.)

STABLE ISOTOPE SEPARATION

Refer also to abstract 8417.

8341

THE SEPARATION OF IONIC ISOTOPES BY ELECTROPHORESIS OF GELS HAVING PORES OF THE SAME ORDER OF SIZE AS THE HYDRATED IONS. Carel-Jan van Oss, Norbert Roger Beyrard, Serge de Mende, and Maurice Bonnemay. Compt. rend. 248, 223-5(1959) Jan. 12. (In French)

The differences in the mobility of two isotopes is explained by a difference of the charge density which is connected to a variation of the degree of solvation. This was proved by electrophoresis in gels whose pores were no larger than the solvated ions. A reduction of the dimension of the pores improved the isotopic separation considerably. (tr-auth)

8342

ELECTROMAGNETIC ISOTOPE SEPARATORS AND THEIR APPLICATION IN NUCLEAR PHYSICS. W. Żuk (Marie Curie-Sklodowsky Univ., Lublin). Nukleonika 3, 499-512(1958). (In Polish)

A short description is given of the mass spectrometer and the theory of mass separation in a homogeneous magnetic field. A detailed description is given of the design of a low, intensity separator of the 90° type giving an ion current of 10^{-5} A and milligram quantities of separated isotopes. The last part of the article is devoted to the problem of the collection of samples of radioactive isotopes of metal foils and the application of such preparations in β and γ spectroscopy. (auth)

8343

HYDROMAGNETIC EQUATIONS FOR TWO ISOTOPES IN A COMPLETELY IONIZED GAS. Joseph Slepian. Phys. Rev. 112, 1441-4(1958) Dec. 1.

The hydromagnetic equation for a completely ionized gas of high density with a single isotope is given, and from it the two hydromagnetic equations with two isotopes is derived. The difference between the accelerations of the isotopes at any internal point is then equal to $\delta M/M$ times $(1/\rho)[j \times B]$, the force on the induced current per unit density due to the magnetic field. It is then shown that the ionic centrifuge gives almost no enrichment of the isotopes deposited, whereas the magneto-ionic expander gives a very high enrichment. (auth)

TECHNOLOGY

Feed Materials

Refer also to abstracts 8433 and 8453.

8344 MCW-1424

Mallinckrodt Chemical Works, St. Louis.

SOME PHYSICAL PROPERTIES OF URANYL NITRATE SOLUTIONS. G. P. Lang and M. O. Nethaway. Dec. 15, 1958. 13p. Contract W-14-108-eng-8. $0.50(OTS).

Boiling points, freezing points, and densities were measured in the concentration range between uranyl nitrate hexahydrate and uranyl nitrate dihydrate. The surface tension of molten uranyl nitrate hexahydrate was determined to be approximately 45 dynes per square centimeter at 90 to 100°C. (auth)

Raw Materials

8345 ORNL-2259

Oak Ridge National Lab., Tenn.

SYNERGISTIC URANIUM EXTRACTANTS: COMBINATION OF NEUTRAL ORGANOPHOSPHORUS COMPOUNDS WITH DIALKYLPHOSPHORIC ACIDS. C. A. Blake, D. E. Horner, and J. M. Schmitt. Feb. 25, 1959. 42p. Contract W-7405-eng-26. $1.25(OTS).

Dialkylphosphoric acids in combination with trialkylphosphates, dialkyl alkylphosphonates, trialkylphosphine oxides, and other neutral organophosphorus compounds have uranium extraction abilities as much as two orders of magnitude stronger than the cumulative abilities of the individual reagents. With the possible exception of plutonium, other metals tested, e.g., iron, aluminum, vanadium, molybdenum, titanium, show no synergistic enhancement of extraction coefficient. Of the acids tested, only dialkylphosphoric acids showed a synergistic enhancement. Extractions can be achieved from sulfate and phosphate solutions in addition to nitrate solutions. Effects of anion concentration, pH and dialkylphosphoric acid concentration are parallel with and without the neutral additive. High neutral additive concentrations decrease uranium extraction. The reagents allow high uranium concentration from very low-grade liquors and are usable with liquors usually difficult to extract. Several useful reagent combinations can be prepared from commercial reagents. (auth)

PATENTS

8346

CASTING METHOD AND APPARATUS. C. F. Gray and R. H. Thompson (to U. S. Atomic Energy Commission). U. S. Patent 2,854,713. Oct. 7, 1958.

An improved apparatus for the melting and casting of uranium is described. A vacuum chamber is positioned over the casting mold and connected thereto, and a rod to pierce the oxide skin of the molten uranium is fitted into the bottom of the melting chamber. The entire apparatus is surrounded by a jacket, and operations are conducted under a vacuum. The improvement in this apparatus lies in the fact that the top of the melting chamber is fitted with a plunger which allows squeezing of the oxide skin to force out any molten uranium remaining after the skin has been broken and the molten charge has been cast.

8347

COPPER COATED URANIUM ARTICLE. A. G. Gray (to U. S. Atomic Energy Commission). U. S. Patent 2,854,737. Oct. 7, 1958.

Various techniques and methods for obtaining copper-coated uranium are given. Specifically disclosed are a group of complex uranium coatings having successive layers of nickel, copper, lead, and tin.

8348

NICKEL COATED URANIUM ARTICLE. A. G. Gray (to U. S. Atomic Energy Commission). U. S. Patent 2,854,738. Oct. 7, 1958.

Nickel coatings on uranium and various methods of obtaining such coatings are described. Specifically disclosed are such nickel or nickel alloy layers as barriers between uranium and aluminum–silicon, chromium, or copper coatings.

8349

LOADING DEVICE. L. A. Ohlinger (to U. S. Atomic Energy Commission). U. S. Patent 2,855,114. Oct. 7, 1958.

A device is presented for loading or charging bodies of fissionable material into a reactor. This device consists of a car, mounted on tracks, into which the fissionable materials may be placed at a remote area, transported to the reactor, and inserted without danger to the operating personnel. The car has mounted on it a heavily shielded magazine for holding a number of the radioactive bodies. The magazine is of a U-shaped configuration and is inclined to the horizontal plane, with a cap covering the elevated open end, and a remotely operated plunger at the lower, closed end. After the fissionable bodies are loaded in the magazine and transported to the reactor, the plunger inserts the body at the lower end of the magazine into the reactor, then is withdrawn, thereby allowing gravity to roll the remaining bodies into position for successive loading in a similar manner.

8350

SEPARATION OF PLUTONIUM FROM URANIUM AND FISSION PRODUCTS. G. E. Boyd, A. W. Adamson, J. Schubert, and E. R. Russell (to U. S. Atomic Energy Commission). U. S. Patent 2,855,269. Oct. 7, 1958.

A chromatographic adsorption process is presented for the separation of plutonium from other fission products formed by the irradiation of uranium. The plutonium and the lighter element fission products are adsorbed on a sulfonated phenol-formaldehyde resin bed from a nitric acid solution containing the dissolved uranium. Successive washes of sulfuric, phosphoric, and nitric acids remove the bulk of the fission products, then an eluate of dilute phosphoric and nitric acids removes the remaining plutonium and fission products. The plutonium is selectively removed by passing this solution through zirconium phosphate, from which the plutonium is dissolved with nitric acid. This process provides a convenient and efficient means for isolating plutonium.

8351

PROCESS OF RECOVERING URANIUM. J. M. Carter and C. E. Larson (to U. S. Atomic Energy Commission). U. S. Patent 2,855,270. Oct. 7, 1958.

A process is presented for recovering uranium values from calutron deposits. The process consists in treating such deposits to produce an oxidized acidic solution containing uranium together with the following impurities: Cu, Fe, Cr, Ni, Mn, Zn. The uranium is recovered from such an impurity-bearing solution by adjusting the pH of the solution to the range 1.5 to 3.0 and then treating the solution with hydrogen peroxide. This results in the precipitation of uranium peroxide which is substantially free of the metal impurities in the solution. The peroxide precipitate is then separated from the solution, washed, and calcined to produce uranium trioxide.

8352

SEPARATION OF URANIUM HEXAFLUORIDE FROM ORGANIC FLUORO COMPOUNDS. W. F. Libby (to U. S. Atomic Energy Commission). U. S. Patent 2,855,271. Oct. 7, 1958.

A method is presented for removing perfluoroörganic compounds such as C_7F_{16} from UF_6. The physical and chemical properties of the perfluoro compounds are such as to render their removal from UF_6 difficulty by conventional techniques. The mixture containing UF_6 and the perfluoro compounds is pyrolyzed in an inert container at high temperature and pressure. The properties of the products obtained by pyrolysis differ from the properties of UF_6 to a sufficient degree to render their separation possible by ordinary methods.

8353

APPARATUS FOR CONDENSATION AND SUBLIMATION. R. J. Schmidt and F. Fuis, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,855,281. Oct. 7, 1958.

An apparatus is presented for the sublimation and condensation of uranium compounds in order to obtain an improved crystalline structure of this material. The apparatus comprises a vaporizing chamber and condensing structure connected thereto. There condenser is fitted with a removable liner having a demountable baffle attached to the liner by means of brackets and a removable pin. The baffle is of spiral cross-section and is provided with cooling coils disposed between the surfaces of the baffle for circulation of a temperature controlling liquid within the baffle. The cooling coil provides for controlling the temperature of the baffle to insure formation of a satisfactory condensate, and the removable liner facilitates the removal of condensate formed during the sublimation process.

8354

NEUTRONIC REACTORS. H. L. Anderson (to U. S. Atomic Energy Commission). U. S. Patent 2,855,354. Oct. 7, 1958.

The design of control rods for nuclear reactors are described. In this design the control rod consists essentially of an elongated member constructed in part of a neutron absorbing material and having tube means extending therethrough for conducting a liquid to cool the rod when in use.

8355

JACKETED URANIUM SLUG. L. A. Ohlinger and C. M. Cooper (to U. S. Atomic Energy Commission). U. S. Patent 2,855,355. Oct. 7, 1958.

Fuel elements for nuclear reactors are described. Each fuel element is comprised of a solid cylindrical slug containing fissionable material enclosed within a fluid tight jacket of neutron permeable material such as aluminum. The jacket is provided with a flexible end cap and with a sealing member having a substantially fluid-tight fit within the jacket in tight abutment with the end cap and the end of the slug. A fluid passage is provided between the end of the slug and the cap whereby leakage fluid is principally directed to the end of the slug. In this manner, any reaction between the fissionable material and fluid which may take place occurs more rapidly at the end of the slug than along the sides between the slug and the jacket, thereby causing longitudinal expansion of the fuel element prior to radial expansion. The longitudinal expansion can be readily detected and the fuel element removed from the coolant

tube before radial expansion causes it to become jammed in the tube.

8356

TAMPERPROOF FILM BADGE. L. F. Kocher (to U. S. Atomic Energy Commission). U. S. Patent 2,855,519. Oct. 7, 1958.

A personnel dosimeter film badge made of plastic, with provision for a picture of the wearer and an internal slide containing photographic film that is sensitive to various radiations, is described. Four windows made of differing material selectively attenuate alpha, beta, gamma rays, and neutrons so as to distinguish the particular type of radiation the wearer was subjected to. In addition, a lead shield has the identification number of the wearer perforated thereon so as to identify the film after processing. An internal magnetically actuated latch securely locks the slide within the body, and may be withdrawn only upon the external application of two strong magnetic forces in order to insure that the wearer or other curious persons will not accidentally expose the film to visual light.

8357

DEVICE FOR CONTROLLING INSERTION OF ROD. B. J. Beaty (to U. S. Atomic Energy Commission). U. S. Patent 2,855,899. Oct. 14, 1958.

A device for rapidly inserting a safety rod into a nuclear reactor upon a given signal or in the event of a power failure in order to prevent the possibility of extensive damage caused by a power excursion is described. A piston is slidably mounted within a vertical cylinder with provision for an electromagnetic latch at the top of the cylinder. This assembly, with a safety rod attached to the piston, is mounted over an access port to the core region of the reactor. The piston is normally latched at the top of the cylinder with the safety rod clear of the core area, however, when the latch is released, the piston and rod drop by their own weight to insert the rod. Vents along the side of the cylinder permit the escape of the air entrapped under the piston over the greater part of the distance, however, at the end of the fall the entrapped air is compressed thereby bringing the safety rod gently to rest, thus providing for a rapid automatic insertion of the rod with a minimum of structural shock.

8358

METAL SPRAYER FOR USE IN VACUUM OR INERT ATMOSPHERE. R. E. Monroe (to U. S. Atomic Energy Commission). U. S. Patent 2,856,237. Oct. 14, 1958.

A metal sprayer is described for use in a vacuum or inert atmosphere with a straight line wire feed and variable electrode contact angle. This apparatus comprises two wires which are fed through straight tubes of two mechanisms positioned on opposite sides of a central tube to which an inert gas is fed. The two mechanisms and the wires being fed constitute electrodes to which electrical current is supplied so that the wires are melted by the electric arc formed at their contacting region and sprayed by the gas supplied by the central tube. This apparatus is designed specifically to apply a zirconium coating to uranium in an inert atmosphere and without the use of an oxidizing flame.

8359

IODATE METHOD FOR PURIFYING PLUTONIUM. R. W. Stoughton and R. B. Duffield (to U. S. Atomic Energy Commission). U. S. Patent 2,856,261. Oct. 14, 1958.

A method is presented for removing radioactive fission products from aqueous solutions containing such fission products together with plutonium. This is accomplished by incorporating into such solutions a metal iodate precipitate to remove fission products which form insoluble iodates. Suitable metal iodates are those of thorium and cerium. The plutonium must be in the hexavalent state and the pH of the solution must be maintained at less than 2.

8360

ADSORPTION PROCEDURE IN PREPARING U^{233}. R. W. Stoughton (to U. S. Atomic Energy Commission). U. S. Patent 2,856,262. Oct. 14, 1958.

A process is presented for the separation of protoactinium and thorium from an aqueous nitric acid solution containing these metals. It comprises contacting the solution with a cation exchange phenol-formaldehyde resin containing sulfonic acid groups, and eluting the adsorbed thorium from the resin by means of aqueous nitric acid. Thereafter the adsorbed protoactinium is eluted from the resin by means of an aqueous solution of ammonium fluoride.

8361

PROCESS FOR THE RECOVERY AND PURIFICATION OF URANIUM DEPOSITS. J. M. Carter and M. D. Kamen (to U. S. Atomic Energy Commission). U. S. Patent 2,856,263. Oct. 14, 1958.

A process is presented for recovering uranium values from UCl_4 deposits formed on calutrons. Such deposits are removed from the calutron parts by an aqueous wash solution which then contains the uranium values in addition to the following impurities: Ni, Cu, Fe, and Cr. This impurity bearing wash solution is treated with an oxidizing agent, and the oxidized solution is then treated with ammonia in order to precipitate the uranium as ammonium diuranate. The metal impurities of iron and chromium, which form insoluble hydroxides, are precipitated along with the uranium values. The precipitate is separated from the solution, dissolved in acid, and the solution again treated with ammonia and ammonium carbonate, which results in the precipitation of the metal impurities as hydroxides while the uranium values remain in solution.

8362

NEUTRONIC REACTOR CONTROL. H. E. Metcalf (to U. S. Atomic Energy Commission). U. S. Patent 2,856,336. Oct. 14, 1958.

Methods of controlling reactors are presented. Specifically, a plurality of neutron absorber members are adjustably disposed in the reactor core at different distances from the center thereof. The absorber members extend into the core from opposite faces thereof and are operated by motive means coupled in a manner to simultaneously withdraw at least one of the absorber members while inserting one of the other absorber members. This feature effects fine control of the neutron reproduction ratio by varying the total volume of the reactor effective in developing the neutronic reaction.

8363

METHOD OF OPERATING NUCLEAR REACTORS. S. Untermyer (to U. S. Atomic Energy Commission). U. S. Patent 2,856,337. Oct. 14, 1958.

A method is presented for obtaining enhanced utilization of natural uranium in heavy water moderated nuclear reactors by charging the reactor with an equal

number of fuel elements formed of natural uranium and of fuel elements formed of uranium depleted in U^{235} to the extent that the combination will just support a chain reaction. The reactor is operated until the rate of burn-up of plutonium equals its rate of production, the fuel elements are processed to recover plutonium, the depleted uranium is discarded, and the remaining uranium is formed into fuel elements. These fuel elements are charged into a reactor along with an equal number of fuel elements formed of uranium depleted in U^{235} to the extent that the combination will just support a chain reaction, and reuse of the uranium is continued as aforesaid until it will no longer support a chain reaction when combined with an equal quantity of natural uranium.

8364

NEUTRONIC REACTORS. E. P. Wigner and G. J. Young (to U. S. Atomic Energy Commission). U. S. Patent 2,856,339. Oct. 14, 1958.

A method is presented for loading and unloading rod type fuel elements of a neutronic reactor of the heterogeneous, solid moderator, liquid cooled type. In the embodiment illustrated, the fuel rods are disposed in vertical coolant channels in the reactor core. The fuel rods are loaded and unloaded through the upper openings of the channels which are immersed in the coolant liquid, such as water. Unloading is accomplished by means of a coffer dam assembly having an outer sleeve which is placed in sealing relation around the upper opening. A radiation shield sleeve is disposed in and reciprocable through the coffer dam sleeve. A fuel rod engaging member operates through the axial bore in the radiation shield sleeve to withdraw the fuel rod from its position in the reactor coolant channel into the shield, the shield and rod then being removed. Loading is accomplished in the reverse procedure.

8365

SHAPED FISSIONABLE METAL BODIES. E. P. Wigner, R. R. Williamson, and G. J. Young (to U. S. Atomic Energy Commission). U. S. Patent 2,856,340. Oct. 14, 1958.

A technique is presented for grooving the surface of fissionable fuel elements so that expansion can take place without damage to the interior structure of the fuel element. The fissionable body tends to develop internal stressing when it is heated internally by the operation of the nuclear reactor and at the same time is subjected to surface cooling by the circulating coolant. By producing a grooved or waffle-like surface texture, the annular lines of tension stress are disrupted at equally spaced intervals by the grooves, thereby relieving the tension stresses in the outer portions of the body while also facilitating the removal of accumulated heat from the interior portion of the fuel element.

8366

NUCLEAR REACTOR SLUG PROVIDED WITH THERMOCOUPLE. W. R. Kanne (to U. S. Atomic Energy Commission). U. S. Patent 2,856,341. Oct. 14, 1958.

A temperature measuring apparatus is described for use in a reactor. In this invention a cylindrical fuel slug is provided with an axial bore in which is disposed a thermocouple. The lead wires extend to a remote indicating device which indicates the temperature in the fuel element measured by the thermocouple.

8367

SEPARATION PROCESS FOR TRANSURANIC ELEMENT AND COMPOUNDS THEREOF. M. Calvin (to U. S. Atomic Energy Commission). U. S. Patent 2,856,418. Oct. 14, 1958.

A process is presented for the separation of plutonium from uranium and fission products in an aqueous acidic solution by use of a chelating agent. The plutonium is maintained in the tetravalent state and the uranium in the hexavalent state, and the acidic concentration is adjusted to about 1 N. The aqueous solution is then contacted with a water-immiscible organic solvent solution and the chelating agent. The chelating agents covered by this invention comprise a group of compounds characterized as fluorinated beta-diketones.

8368

INERT GAS SHIELD FOR WELDING. S. O. Jones and F. V. Daly (to U. S. Atomic Energy Commission). U. S. Patent 2,856,510. Oct. 14, 1958.

An inert gas shield is presented for arc-welding materials such as zirconium that tend to oxidize rapidly in air. The device comprises a rectangular metal box into which the welding electrode is introduced through a rubber diaphragm to provide flexibility. The front of the box is provided with a window having a small hole through which filler metal is introduced. The box is supplied with an inert gas to exclude the atmosphere, and with cooling water to promote the solidification of the weld while in the inert atmosphere. A separate water-cooled copper backing bar is provided underneath the joint to be welded to contain the melt-through at the root of the joint, shielding the root of the joint with its own supply of inert gas and cooling the deposited weld metal. This device facilitates the welding of large workpieces of zirconium frequently encountered in reactor construction.

8369

GATING CIRCUITS. L. C. Merrill (to U. S. Atomic Energy Commission). U. S. Patent 2,856,526. Oct. 14, 1958.

Control circuits for vacuum tubes are described, and a binary counter having an improved trigger circuit is reported. The salient feature of the binary counter is the application of the input signal to the cathode of each of two vacuum tubes through separate capacitors and the connection of each cathode to ground through separate diodes. The control of the binary counter is achieved in this manner without special pulse shaping of the input signal. A further advantage of the circuit is the simplicity and minimum number of components required, making its use particularly desirable in computer machines.

8370

PULSED ION SOURCE. E. F. Martina (to U. S. Atomic Energy Commission). U. S. Patent 2,856,532. Oct. 14, 1958.

An improved pulsed ion source of the type where the gas to be ionized is released within the source by momentary heating of an electrode occluded with the gas is presented. The other details of the ion source construction include an electron emitting filament and a positive reference grid, between which an electron discharge is set up, and electrode means for withdrawing the ions from the source. Due to the location of the gas source behind the electrode discharge region, and the positioning of the vacuum exhaust system on the opposite side of the discharge, the released gas is drawn into the electron discharge and ionized in accurately controlled amounts. Consequently, the output pulses of the ion source may be accurately controlled.

8371

PROCESS USING POTASSIUM LANTHANUM SULFATE FOR FORMING A CARRIER PRECIPITATE FOR PLUTONIUM VALUES. A. A. Angerman (to U. S. Atomic Energy Commission). U. S. Patent 2,857,241. Oct. 21, 1958.

A process is presented for recovering plutonium values in an oxidation state not greater than +4 from fluoride-soluble fission products. The process consists of adding to an aqueous acidic solution of such plutonium values a crystalline potassium lanthanum sulfate precipitate which carries the plutonium values from the solution.

8372

SUPERCONDUCTING VANADIUM BASE ALLOY. H. J. Cleary (to U. S. Atomic Energy Commission). U. S. Patent 2,857,268. Oct. 21, 1958.

A new vanadium-base alloy which possesses remarkable superconducting properties is presented. The alloy consists of approximately one atomic percent of palladium, the balance being vanadium. The alloy is stated to be useful in a cryotron in digital computer circuits.

8373

HIGH TEMPERATURE REFRACTORY COATING FOR GRAPHITE MOLDS. S. D. Stoddard (to U. S. Atomic Energy Commission). U. S. Patent 2,857,285. Oct. 21, 1958.

An improved foundry mold coating for use with graphite molds used in the casting of uranium is presented. The refractory mold coating serves to keep the molten uranium from contact with graphite of the mold and thus prevents carbon pickup by the molten metal. The refractory coating is made by dry mixing certain specific amounts of aluminum oxide, bentonite, Tennessee ball clay, and a soluble silicate salt. Water is then added to the mixture and the suspension thus formed is applied by spraying onto the mold.

8374

ENGINEERING TEST REACTOR. D. R. De Boisblanc, M. E. Thomas, R. M. Jones, and G. H. Hanson (to U. S. Atomic Energy Commission). U. S. Patent 2,857,324. Oct. 21, 1958.

Heterogeneous reactors of the type which is both cooled and moderated by the same fluid, preferably water, and employs highly enriched fuel are reported. In this design, an inner pressure vessel is located within a main outer pressure vessel. The reactor core and its surrounding reflector are disposed in the inner pressure vessel which in turn is surrounded by a thermal shield. Coolant fluid enters the main pressure vessel, flows downward into the inner vessel where it passes through the core containing the fissionable fuel assemblies and control rods, through the reflector, thence out through the bottom of the inner vessel and up past the thermal shield to the discharge port in the main vessel. The fuel assemblies are arranged in the core in the form of a cross having an opening extending therethrough to serve as a high fast flux test facility.

8375

DISTRIBUTED AMPLIFIER INCORPORATING FEEDBACK. P. R. Bell, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,857,483. Oct. 21, 1958.

An improved distributed amplifier system employing feedback for stabilization is presented. In accordance with the disclosed invention, a signal to be amplified is applied to one end of a suitable terminated grid transmission line. At intervals along the transmission line, the signal is fed to stable, resistance-capacitance coupled amplifiers incorporating feedback loops therein. The output current from each amplifier is passed through an additional tube to minimize the electrostatic capacitance between the tube elements of the last stage of the amplifier, and fed to appropriate points on an output transmission line, similar to the grid line, but terminated at the opposite (input) end. The output taken from the unterminated end of the plate transmission line is proportional to the input voltage impressed upon the grid line.

8376

SEPARATION OF FLUID MIXTURES. R. Lipscomb, A. Craig, S. Labrow, and J. F. Dunn (to U. S. Atomic Energy Commission). U. S. Patent 2,857,745. Oct. 28, 1958.

An apparatus is presented for separating gaseous mixtures by selectively freezing a constituent of the mixture and subsequently separating the frozen gas. The gas mixture is passed through a cylinder fitted with a cooling jacket, causing one gas to freeze on the walls of the cylinder. A set of scraper blades are provided in the interior of the cylinder, and as the blades oscillate, the frozen gas is scraped to the bottom of the cylinder. Means are provided for the frozen material to pass into a heating chamber where it is vaporized and the product gas collected.

8377

URANIUM RECOVERY. F. T. Fitch and A. J. Cruikshank (to U. S. Atomic Energy Commission). U. S. Patent 2,858,187. Oct. 28, 1958.

A process for recovering uranium from a solution of a diethyl dithiocarbamate of uranium in an organic solvent substantially immiscible with water is presented. The process comprises bringing the organic solution into intimate contact with an aqueous solution of ammonium carbonate, whereby the uranium passes to the aqueous carbonate solution as a soluble uranyl carbonate.

8378

EXTRACTION APPARATUS. A. E. Ballard and H. R. Brigham (to U. S. Atomic Energy Commission). U. S. Patent 2,858,196. Oct. 28, 1958.

An apparatus whereby relatively volatile solvents may be contacted with volatile or non-volatile material without certain attendant hazards is described. A suitable apparatus for handling relatively volatile liquids may be constructed comprising a tank, and a closure covering the tank and adapted to be securely attached to an external support. The closure is provided with a rigidly mounted motor-driven agitator. This agitator is connected from the driving motor into the interior of the tank through a gland adapted to be cooled with inert gas thereby eliminating possible hazard due to frictional heat. The closure is arranged so that the tank may be removed from it without materially disturbing the closure which, as described, carries the motor driven agitator and other parts.

8379

PROTECTIVELY COVERED ARTICLE AND METHOD OF MANUFACTURE. R. F. Plott (to U. S. Atomic Energy Commission). U. S. Patent 2,858,262. Oct. 28, 1958.

A method of casting a protective jacket about a ura-

nium fuel element that will bond completely to the uranium without the use of stringers or supports that would ordinarily produce gaps in the cast metal coating and bond is presented. Preformed endcaps of aluminum alloyed with 13% silicon are placed on the ends of the uranium fuel element. These caps will support the fuel element when placed in a mold. The mold is kept at a temperature slightly above the melting point of the casting alloy but below that of uranium so the cast metal jacket will fuse with the endcaps forming a complete covering and bond to the fuel element, which would otherwise oxidize at the gaps or discontinuities left in the coating by previous casting methods.

8380

RADIATION DOSIMETER AND DOSIMETRIC METHODS. G. V. Taplin (to U. S. Atomic Energy Commission). U. S. Patent 2,858,447. Oct. 28, 1958.

The determination of ionizing radiation by means of single fluid phase chemical dosimeters of the colorimetric type is presented. A single fluid composition is used consisting of a chlorinated hydrocarbon, an acidimetric dye, a normalizer and water. Suitable chlorinated hydrocarbons are carbon tetrachloride, chloroform, trichloroethylene, trichlorethane, ethylene dichloride and tetrachloroethylene. Suitable acidimetric indicator dyes are phenol red, bromcresol purple, and creosol red. Suitable normalizers are resorcinol, geraniol, meta cresol, α-tocopherol, and α-naphthol.

8381

RADIATION WAVE DETECTOR. L. F. Wouters (to U. S. Atomic Energy Commission). U. S. Patent 2,858,452. Oct. 28, 1958.

The detection of the shape and amplitude of a radiation wave is discussed, particularly an apparatus for automatically indicating at spaced intervals of time the radiation intensity at a fixed point as a measure of a radiation wave passing the point. The apparatus utilizes a number of photomultiplier tubes surrounding a scintillation type detector. For obtaining time spaced signals proportional to radiation at predetermined intervals the photomultiplier tubes are actuated in sequence following detector incidence of a predetermined radiation level by electronic means. The time spaced signals so produced are then separately amplified and relayed to recording means.

8382

CRUCIBLE LINING METHOD. W. H. Bone and W. W. Schmidt (to U. S. Atomic Energy Commission). U. S. Patent 2,858,596. Nov. 4, 1958.

A method is presented for forming refractory liners in cylindrical reaction vessels used for the reduction of uranium tetrafluoride to metallic uranium. A preliminary form, having positioning lugs attached thereto, is inserted into the reaction vessel and the refractory powder, usually CaO, is put in the annular space between the form and the inner wall of the reaction vessel. A jolting table is used to compact this charge of liner material in place, and after this has been done, the preliminary form is removed and the final form or plug is inserted without disturbing the partially completed lining. The remainder of the lining charge is then introduced and compacted by jolting, after which the form is removed.

8383

SOLVENT EXTRACTION PROCESS FOR THE RECOVERY OF METALS FROM PHOSPHORIC ACID. R. H. Bailes and R. S. Long (to U. S. Atomic Energy Commission). U. S. Patent 2,859,092. Nov. 4, 1958.

A solvent extraction process is presented for recovering metal values including uranium, thorium, and other lanthanide and actinide elements from crude industrial phosphoric acid solutions. The process consists of contacting said solution with an immiscible organic solvent extractant containing a diluent and a material selected from the group consisting of mono and di alkyl phosphates, alkyl phosphonates and alkyl phosphites. The uranium enters the extractant phase and is subsequently recovered by any of the methods known to the art. Recovery is improved if the phosphate solution is treated with a reducing agent such as iron or aluminum powder prior to the extraction step.

8384

ZIRCONIUM PHOSPHATE ADSORPTION METHOD. E. R. Russell, A. S. Adamson, J. Schubert, and G. E. Boyd (to U. S. Atomic Energy Commission). U. S. Patent 2,859,093. Nov. 4, 1958.

A method is presented for separating plutonium values from fission product values in aqueous acidic solution. This is accomplished by flowing the solution containing such values through a bed of zirconium orthophosphate. Any fission products adsorbed can subsequently be eluted by washing the column with a solution of 2N HNO_3 and 0.1N H_3PO_4. Plutonium values may subsequently be desorbed by contacting the column with a solution of 7N HNO_3.

8385

URANIUM EXTRACTION PROCESS USING SYNERGISTIC REAGENTS. J. M. Schmitt, C. A. Blake, Jr., K. B. Brown, and C. F. Coleman (to U. S. Atomic Energy Commission). U. S. Patent 2,859.094. Nov. 4, 1958.

Improved methods are presented for recovering uranium values from aqueous solutions by organic solvent extraction. The improvement lies in the use, in combination, of two classes of organic compounds so that their extracting properties are enhanced synergistically. The two classes of organic compounds are dialkylphosphoric acid and certain neutral organophosphorus compounds such as trialkylphosphates, trialkylphosphonates, trialkylphosphinates and trialkylphosphine oxides.

8386

PROCESS OF PRODUCING Cm^{244} AND Cm^{245}. W. M. Manning, M. H. Studier, H. Diamond, and P. R. Fields (to U. S. Atomic Energy Commission). U. S. Patent 2,859,095. Nov. 4, 1958.

A process is presented for producing Cm^{244} and Cm^{245}. The first step of the process consists in subjecting Pu^{239} to a high neutron flux and subsequently dissolving the irradiated material in HCl. The plutonium is then oxidized to at least the tetravalent state and the solution is contacted with an anion exchange resin, causing the plutonium values to be absorbed while the fission products and transplutonium elements remain in the effluent solution. The effluent solution is then contacted with a cation exchange resin causing the transplutonium values to be absorbed while the fission products remain in solution. The cation exchange resin is then contacted with an aqueous citrate solution and the transplutonium elements are thereby differentially eluted in order of decreasing atomic weight, allowing collection of the desired fractions.

8387

PROCESS FOR PRODUCTION OF URANIUM HEXAFLUORIDE. R. D. Fowler (to U. S. Atomic Energy Commission). U. S. Patent 2,859,096. Nov. 4, 1958.

A process is described for the manufacture of uranium hexafluoride which consists in contacting an oxide of uranium simultaneously with elemental carbon and elemental fluorine at an elevated temperature, using a proportion of the carbon to the oxide about 50% in excess of that theoretically required to combine with all of the oxygen as CO_2. The process has the advantage that the uranium oxide is reduced by the carbon and converted to the hexafluoride in a single operation.

8388

PREPARATION OF PLUTONIUM HALIDES. N. R. Davidson and J. J. Katz (to U. S. Atomic Energy Commission). U. S. Patent 2,859,097. Nov. 4, 1958.

A process is presented for the preparation of plutonium trihalides. Plutonium oxide or a compound which may be readily converted to plutonium oxide, for example, a plutonium hydroxide or plutonium oxalate is contacted with a suitable halogenating agent. Specific agents mentioned are carbon tetrachloride, carbon tetrabromide, sulfur dioxide, and phosphorus pentachloride. The reaction is carried out under superatmospheric pressure at about 300°C.

8389

COMPOSITION AND METHOD FOR COATING A CERAMIC BODY. M. K. Blanchard (to U. S. Atomic Energy Commission). U. S. Patent 2,859,138. Nov. 4, 1958.

A method is presented for protecting a beryllium carbide-graphite body. The method consists in providing a ceramic coating which must contain at least one basic oxide component, such as CaO, at least one amphoteric oxide component, such as Al_2O_3, and at least one acidic oxide component, such as SiO_2. Various specific formulations for this ceramic coating are given and the coating is applied by conventional ceramic techniques.

8390

ELECTROLYTIC PREPARATION OF UF_4. A. L. Allen, R. W. Anderson, and E. W. Powell (to U. S. Atomic Energy Commission). U. S. Patent 2,859,156. Nov. 4, 1958.

A method is presented for converting hexavalent uranium to uranium tetrafluoride. The method consists of electrolyzing a solution of uranyl fluoride in hydrofluoric acid at about 90°C. The uranyl ions are reduced at the cathode and a hydrated uranium tetrafluoride precipitates. The precipitate is separated and subsequently dehydrated to UF_4.

8391

CADMIUM-RARE EARTH BORATE GLASS AS REACTOR CONTROL MATERIAL. G. L. Ploetz and W. E. Ray (to U. S. Atomic Energy Commission). U. S. Patent 2,859,163. Nov. 4, 1958.

A reactor control rod fabricated from a cadmium-rare earth-borate glass is presented. The rare earth component of this glass is selected from among those rare earths having large neutron capture cross sections, such as samarium, gadolinium or europium. Particles of this glass are then dispersed in a metal matrix by standard powder metallurgy techniques.

8392

SAMPLING DEVICE FOR pH MEASUREMENT IN PROCESS STREAMS. C. E. Michelson and W. N. Carson, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,859,164. Nov. 4, 1958.

A pH cell is presented for monitoring the hydrogen ion concentration of a fluid in a process stream. The cell is made of glass with a side entry arm just above a reservoir in which the ends of a glass electrode and a reference electrode are situated. The glass electrode contains the usual internal solution which is connected to a lead. The reference electrode is formed of saturated calomel having a salt bridge in its bottom portion fabricated of a porous glass to insure low electrolyte flow. A flush tube leads into the cell through which buffer and flush solutions are introduced. A ground wire twists about both electrode ends to insure constant electrical grounding of the sample. The electrode leads are electrically connected to a pH meter of any standard type.

8393

CIRCUITS FOR CURRENT MEASUREMENTS. R. J. Cox (to U. S. Atomic Energy Commission). U. S. Patent 2,859,353. Nov. 4, 1958.

Circuits are presented for measurement of a logarithmic scale of current flowing in a high impedance. In one form of the invention the disclosed circuit is in combination with an ionization chamber to measure ionization current. The particular circuit arrangement includes a vacuum tube having at least one grid, an ionization chamber connected in series with a high voltage source and the grid of the vacuum tube, and a d-c amplifier feedback circuit. As the ionization chamber current passes between the grid and cathode of the tube, the feedback circuit acts to stabilize the anode current, and the feedback voltage is a measure of the logarithm of the ionization current.

8394

VISUAL ALARM SYSTEM. J. M. Morris (to U. S. Atomic Energy Commission). U. S. Patent 2,859,431. Nov. 4, 1958.

A visual alarm system, particularly a system incorporating a gas-filled diode glow bulb, for indicating a minor alarm and also a major alarm is presented. In operation, the disclosed system responds to a signal indicative of a caution condition by applying a d-c voltage across the glow bulb to induce a glow at one electrode. If a signal indicative of a critical condition is received, the system applies an a-c voltage across the glow bulb to produce a glow discharge at each electrode.

8395

PROCESS FOR UTILIZING ORGANIC ORTHOPHOSPHATE EXTRACTANTS. R. R. Grinstead (to U. S. Atomic Energy Commission). U. S. Patent 2,860,031. Nov. 11, 1958.

A process is presented for recovering uranium from its ores, the steps comprising producing the uranium in solution in the trivalent state, extracting the uranium from solution in an immiscible organic solvent extract phase which includes mono and dialkyl orthophosphoric acid esters having a varying number of carbon atoms on the alkyl substituent, and recovering the uranium from the extract phase.

8396

WET METHOD OF PREPARING PLUTONIUM TRIBROMIDE. N. R. Davidson and E. K. Hyde (to U. S.

Atomic Energy Commission). U. S. Patent 2,860,032. Nov. 11, 1958.

The preparation of anhydrous plutonium tribromide from an aqueous acid solution of plutonium tetrabromide is described, consisting of adding a water-soluble volatile bromide to the tetrabromide to provide additional bromide ions sufficient to furnish an oxidation-reduction potential substantially more positive than −0.966 volt, evaporating the resultant plutonium tribromides to dryness in the presence of HBr, and dehydrating at an elevated temperature also in the presence of HBr.

8397

ISOTOPE CONVERSION DEVICE AND METHOD. E. P. Wigner and L. A. Ohlinger (to U. S. Atomic Energy Commission). U. S. Patent 2,860,093. Nov. 11, 1958.

Homogeneous nuclear reactors are discussed, and an apparatus and method of operation are described. The apparatus consists essentially of a reaction tank, a heat exchanger connected to the reaction tank and two separate surge tanks connected to the heat exchanger. An oscillating differential pressure is applied to the surge tanks so that a portion of the homogeneous fissionable solution is circulated through the heat exchanger and reaction tank while maintaining sufficient solution in the reaction tank to sustain a controlled fission chain reaction. The reaction tank is disposed within another tank containing a neutron absorbing material through which coolant fluid is circulated, the outer tank being provided with means to permit and cause rotation thereof due to the circulation of the coolant therethrough.

8398

RATIO COMPUTER. R. F. Post (to U. S. Atomic Energy Commission). U. S. Patent 2,860,241. Nov. 11, 1958.

An electronic computer circuit is described for producing an output voltage proportional to the product or quotient of the voltages of a pair of input signals. In essence, the disclosed invention provides a computer having two channels adapted to receive separate input signals and each having amplifiers with like fixed amplification factors and like negative feedback amplifiers. One of the channels receives a constant signal for comparison purposes, whereby a difference signal is produced to control the amplification factors of the variable feedback amplifiers. The output of the other channel is thereby proportional to the product or quotient of input signals depending upon the relation of input to fixed signals in the first mentioned channel.

8399

DIFFERENTIAL PULSE HEIGHT DISCRIMINATOR. L. D. Test (to U. S. Atomic Energy Commission). U. S. Patent 2,860,242. Nov. 11, 1958.

Pulse-height discriminators are described, specifically a differential pulse-height discriminator which is adapted to respond to pulses of a band of amplitudes, but to reject pulses of amplitudes greater or less than the preselected band. In general, the discriminator includes a vacuum tube having a plurality of grids adapted to cut off plate current in the tube upon the application of sufficient negative voltage. One grid is held below cutoff, while a positive pulse proportional to the amplitude of each pulse is applied to this grid. Another grid has a negative pulse proportional to the amplitude of each pulse simultaneously applied to it. With this arrangement the tube will only pass pulses which are of sufficient amplitude to counter the cutoff bias but not of sufficient amplitude to cutoff the tube.

8400

GAS DISCHARGE DEVICES. S. Jefferson (to U. S. Atomic Energy Commission). U. S. Patent 2,860,269. Nov. 11, 1958.

An apparatus utilized in introducing tritium gas into the envelope of a gas discharge device for the purpose of maintaining the discharge path in ionized condition is described. In addition to the cathode and anode, the discharge device contains a zirconium or tantalum filament arranged for external excitation and a metallic seed containing tritium, and also arranged to have a current passed through it. Initially, the zirconium or tantalum filament is vaporized to deposit its material adjacent the main discharge region. Then the tritium gas is released and, due to its affinity for the first released material, it deposits in the region of the main discharge where it is most effective in maintaining the discharge path in an ionized condition.

8401

PULSED ION SOURCE. F. C. Ford, J. W. Ruff, S. G. Zizzo, and B. Cook (to U. S. Atomic Energy Commission). U. S. Patent 2,860,270. Nov. 11, 1958.

An ion source is described adapted for pulsed operation and producing copious quantities of ions with a particular ion egress geometry. The particular source construction comprises a conical member having a conducting surface formed of a metal with a gas occluded therein and narrow non-conducting portions thereon dividing the conducting surface. A high voltage pulse is applied across the conducting surface for producing a discharge across the surface. After the gas ions have been produced by the discharge, the ions are drawn from the source in a diverging conical beam by a specially constructed accelerating electrode.

8402

SEPARATION OF NEPTUNIUM FROM PLUTONIUM BY CHLORINATION AND SUBLIMATION. S. M. Fried (to U. S. Atomic Energy Commission). U. S. Patent 2,860,948. Nov. 18, 1958.

A process is described for separating neptunium from plutonium. The method consists in chlorinating a mixture of the oxides of Np and Pu by contacting the mixture with carbon tetrachloride at about 500°C. In this manner the Np is converted to the tetrachloride and the Pu is converted to the trichloride. Since $NpCl_4$ is more volatile than $PuCl_3$, the separation is effected by vaporizing and subsequently condensing the $NpCl_4$.

8403

PLUTONIUM SEPARATION METHOD. L. J. Beaufait, Jr., F. R. Stevenson, and G. K. Rollefson (to U. S. Atomic Energy Commission). U. S. Patent 2,860,949. Nov. 18, 1958.

The recovery of plutonium ions from neutron-irradiated uranium can be accomplished by buffering an aqueous solution of the irradiated materials containing tetravalent plutonium to a pH of 4 to 7, adding sufficient acetate to the solution to complex the uranyl present, adding ferric nitrate to form a colloid of ferric hydroxide, plutonium, and associated fission products, removing and dissolving the colloid in aqueous nitric acid, oxidizing the plutonium to the hexavalent state by adding permanganate or dichromate, treating the resultant solution with ferric nitrate to form a colloid of ferric hydroxide and associated fission products, and separating the colloid from the plutonium left in solution.

8404

METHOD OF PREPARING METAL HALIDES. A. V. Hendrickson (to U. S. Atomic Energy Commission). U. S. Patent 2,860,950. Nov. 18, 1958.

The conversion of plutonium halides from plutonium peroxide can be done by washing the peroxide with hydrogen peroxide, drying the peroxide, passing a dry gaseous hydrohalide over the surface of the peroxide at a temperature of about 100°C until the reaction rate has stabilized, and then raising the reaction temperature to between 400 and 600°C until the conversion to plutonium halide is substantially complete.

8405

PRODUCTION OF METALS AND THEIR COMPOUNDS. T. V. Arden, F. H. Burstall, G. R. Davies, R. P. Linstead, and R. A. Wells (to U. S. Atomic Energy Commission). U. S. Patent 2,860,956. Nov. 18, 1958.

Zirconium nitrate can be separated from hafnium nitrate by mixing the nitrates with ethyl cellulose pulp, eluting the mass with diethyl ether containing nitric acid, and passing the eluent through a column of cellulose pulp the outflow of which is substantially free of hafnium.

8406

HORIZONTAL BOILING REACTOR SYSTEM. M. Treshow (to U. S. Atomic Energy Commission). U. S. Patent 2,861,033. Nov. 18, 1958.

Reactors of the boiling water type are described wherein water serves both as the moderator and coolant. The reactor system consists essentially of a horizontal pressure vessel divided into two compartments by a weir, a thermal neutronic reactor core having vertical coolant passages and designed to use water as a moderator-coolant positioned in one compartment, means for removing live steam from the other compartment and means for conveying feed-water and water from the steam compartment to the reactor compartment. The system further includes auxiliary apparatus to utilize the steam for driving a turbine and returning the condensate to the feed-water inlet of the reactor. The entire system is designed so that the reactor is self-regulating and has self-limiting power and self-limiting pressure features.

8407

NEUTRONIC REACTOR SHIELD AND SPACER CONSTRUCTION. E. P. Wigner and L. A. Ohlinger (to U. S. Atomic Energy Commission). U. S. Patent 2,861,034. Nov. 18, 1958.

Reactors of the heterogeneous, graphite moderated, fluid cooled type and shielding and spacing plugs for the coolant channels thereof are reported. In this design, the coolant passages extend horizontally through the moderator structure, accommodating the fuel elements in abutting end-to-end relationship, and have access openings through the outer shield at one face of the reactor to facilitate loading of the fuel elements. In the outer ends of the channels which extend through the shields are provided spacers and shielding plugs designed to offer minimal resistance to coolant fluid flow while preventing emanation of harmful radiation through the access openings when closed between loadings.

8408

CONTROL ROD. W. H. Zinn and H. V. Ross (to U. S. Atomic Energy Commission). U. S. Patent 2,861,035. Nov. 18, 1958.

A control rod is described for a nuclear reactor. In certain reactor designs it becomes desirable to use a control rod having great width but relatively little thickness. This patent is addressed to such a need. The neutron absorbing material is inserted in a triangular tube, leaving voids between the circular insert and the corners of the triangular tube. The material is positioned within the tube by the use of dummy spacers to achieve the desired absorption pattern, then the ends of the tubes are sealed with suitable plugs. The tubes may be welded or soldered together to form two flat surfaces of any desired width, and covered with sheetmetal to protect the tubes from damage. This design provides a control member that will not distort under the action of outside forces or be ruptured by gases generated within the jacketed control member.

8409

ELECTRONIC PULSE SCALING CIRCUITS. E. H. Cooke-Yarborough (to U. S. Atomic Energy Commission). U. S. Patent 2,861,201. Nov. 18, 1958.

Electronic pulse scaling circuits of the kind comprising a series of bi-stable elements connected in sequence, usually in the form of a ring so as to be cyclically repetitive at the highest scaling factor, are described. The scaling circuit comprises a ring system of bi-stable elements each arranged on turn-off to cause a succeeding element of the ring to be turned-on, and one being arranged on turn-off to cause a further element of the ring to be turned-on. In addition, separate means are provided for applying a turn-off pulse to all the elements simultaneously, and for resetting the elements to a starting condition at the end of each cycle.

8410

MAGNETOMETER. M. A. Leavitt (to U. S. Atomic Energy Commission). U. S. Patent 2,861,242. Nov. 18, 1958.

A magnetometer is described, particularly to a device which accurately indicates the polarity and intensity of a magnetic field. The main feature of the invention is a unique probe construction in combination with a magnetic field detector system. The probe comprises two coils connected in series opposition for energization with an a-c voltage. The voltage induced in a third coil on the probe, a pick-up coil, is distorted by the presence of an external field to produce even harmonic voltages. A controlled d-c current is passed through the energized coils to counter the distortion and reduce the even harmonic content to a null. When the null point is reached, the d-c current is a measure of the external magnetic field strength, and the phase of the pickup coil voltage indicates the field polarity.

8411

ACCELEROMETER. K. E. Pope (to U. S. Atomic Energy Commission). U. S. Patent 2,861,789. Nov. 25, 1958.

A device, commonly known as an accelerometer, is described which may be utilized for measuring acceleration with high sensitivity and accuracy throughout a relatively wide range of values. In general, the accelerometer consists of an assembly, including an electric motor stator and a mass element located away from the axis of rotation of the stator, rotatably mounted on a support, and an electric motor rotor positioned within the stator and rotatable therein. An electrical switching circuit controlled by the movement of the stator intermittently energizes the rotor winding and retards move-

ment of the stator, and a centrifugal switch is rotatable with the rotor to operate upon attainment of a predetermined rotor rotational velocity.

8412

WET FLUORIDE SEPARATION METHOD. G. T. Seaborg, J. W. Gofman, and R. W. Stoughton (to U. S. Atomic Energy Commission). U. S. Patent 2,861,866. Nov. 25, 1958.

The separation of U^{233} from thorium, protactinium, and fission products present in neutron-irradiated thorium is accomplished by dissolving the irradiated materials in aqueous nitric acid, adding either a soluble fluoride, iodate, phosphate, or oxalate to precipitate the thorium, separating the precipitate from the solution, and then precipitating uranium and protactinium by alkalizing the solution. The uranium and protactinium precipitate is removed from the solution and dissolved in nitric acid. The uranyl nitrate may then be extracted from the acid solution by means of ether, and the protactinium recovered from the aqueous phase.

8413

MULTI-CHANNEL PULSE HEIGHT ANALYZER. K. Boyer and C. W. Johnstone (to U. S. Atomic Energy Commission). U. S. Patent 2,862,105. Nov. 25, 1958.

An improved multi-channel pulse height analyzer of the type where the device translates the amplitude of each pulse into a time duration electrical quantity which is utilized to control the length of a train of pulses forwarded to a scaler is described. The final state of the scaler for any one train of pulses selects the appropriate channel in a magnetic memory in which an additional count of one is placed. The improvement consists of a storage feature for storing a signal pulse so that in many instances when two signal pulses occur in rapid succession, the second pulse is preserved and processed at a later time.

8414

REGENERATIVE TRANSISTOR AMPLIFIER. L. J. Kabell (to U. S. Atomic Energy Commission). U. S. Patent 2,862,113. Nov. 25. 1958.

Electrical circuits for use in computers and the like are described, particularly a regenerative bistable transistor amplifier which is turned on by a clock signal when an information signal permits and is turned off by the clock signal. The amplifier performs the above function with reduced power requirements for the clock signal and circuit operation. The power requirements are reduced in one way by employing transformer coupling which increases the collector circuit efficiency by eliminating the loss of power in the collector load resistor.

8415

FORMATION BY IRRADIATION OF AN EXPANDED, CELLULAR, POLYMERIC BODY. A. Charlesby and M. Ross (to U. S. Atomic Energy Commission). U. S. Patent 2,862,862. Dec. 2, 1958.

The treatment of polymeric esters of methacrylic acid having a softening point above 40°C to form an expanded cellular mass with a smooth skin is discussed. The disclosed method comprises the steps of subjecting the body at a temperature below the softening point to a dose of at least 5×10^6 roentgen of gamma radiation from cobalt-60 source until its average molecular weight is reduced to a value within the range of 3×10^5 to 10^4, and heating at a temperature within the range of 0 to 10°C above its softening point to effect expansion.

8416

METHOD OF MEASURING THE INTEGRATED ENERGY OUTPUT OF A NEUTRONIC CHAIN REACTOR. W. J. Sturm (to U. S. Atomic Energy Commission). U. S. Patent 2,863,062. Dec. 2, 1958.

A method is presented for measuring the integrated energy output of a reactor consisting of the steps of successively irradiating calibrated thin foils of an element, such as gold, which is rendered radioactive by exposure to neutron flux for periods of time not greater than one-fifth the mean life of the induced radioactivity and producing an indication of the radioactivity induced in each foil, each foil being introduced into the reactor immediately upon removal of its predecessor.

8417

METHOD OF SEPARATING HYDROGEN ISOTOPES. O. N. Salmon (to U. S. Atomic Energy Commission). U. S. Patent 2,863,526. Dec. 9, 1958.

The process of separating a gaseous mixture of hydrogen and tritium by contacting finely divided palladium with the mixture in order to adsorb the gases, then gradually heating the palladium and collecting the evolved fractions, is described. The fraction first given off is richer in tritium than later fractions.

8418

SULPHUR DIOXIDE LEACHING OF URANIUM CONTAINING MATERIAL. A. Thunaes, F. T. Rabbits, K. D. Hester, and H. W. Smith (to U. S. Atomic Energy Commission). U. S. Patent 2,863,716. Dec. 9, 1958.

A process is described for extracting uranium from uranium containing material, such as a low grade pitchblende ore, or mill tailings, where at least part of the uranium is in the +4 oxidation state. After comminuting and magnetically removing any entrained iron particles the general material is made up as an aqueous slurry containing added ferric and manganese salts and treated with sulfur dioxide and aeration to an extent sufficient to form a proportion of oxysulfur acids to give a pH of about 1 to 2 but insufficient to cause excessive removal of the sulfur dioxide gas. After separating from the solids, the leach solution is adjusted to a pH of about 1.25, then treated with metallic iron in the presence of a precipitant such as a soluble phosphate, arsonate, or fluoride.

8419

PLUTONIUM CONCENTRATION AND DECONTAMINATION METHOD. D. C. Overholt and F. W. Tober (to U. S. Atomic Energy Commission). U. S. Patent 2,863,718. Dec. 9, 1958.

Plutonium can be removed from a solution containing uranium-irradiated materials by adjusting the solution to fractional-normal nitric acid concentration while reducing the plutonium ion to the tetravalent state by adding hydrazine, ferrous sulfamate, or hydroxylamine sulfate, contacting the solution with a cation exchanger such as $Na_2O \cdot Al_2O_3 \times SiO_2 \cdot yH_2O$, and then selectively eluting the absorbed plutonium with 4 molar nitric acid. If the cation exchanger contains sulfonic acid, uranium is absorbed and selectively eluted with dilute sulfuric acid.

8420

METHOD OF IMPROVING THE CARRIER PRECIPITATION OF PLUTONIUM. H. J. Kamack and J. H. Balthis (to U. S. Atomic Energy Commission). U. S. Patent 2,863,719. Dec. 9, 1958.

Plutonium values can be recovered from acidic solutions by adding lead nitrate, hydrogen fluoride, lantha-

num nitrate, and sulfuric acid to the solution to form a carrier precipitate. The lead sulfate formed improves the separation characteristics of the lanthanum fluoride carrier precipitate.

8421

COMBINATION OF HYDROGEN AND OXYGEN. H. F. McDuffie and C. H. Secoy (to U. S. Atomic Energy Commission). U. S. Patent 2,863,729. Dec. 9, 1958.

An efficient and improved method is described for continuously recombining hydrogen and oxygen resulting from subjection of an aqueous solution to ionizing radiations, such as in the case of an aqueous homogeneous fueled nuclear reactor. The method consists in providing copper ions in the solution to an extent of from 0.001 molar to about 0.2 molar, and at a temperature of from 150°C to about 450°C, with corresponding pressure.

8422

SYSTEM FOR CONVERSION OF UF_4 TO UF_6. D. G. Brater and J. W. Pike (to U. S. Atomic Energy Commission). U. S. Patent 2,863,735. Dec. 9, 1958.

Method and apparatus are presented for rapid and complete conversion of solid, powdered uranium tetrafluoride to uranium hexafluoride by treating the UF_4 with fluorine gas at a temperature of about 800°C.

8423

NEUTRONIC REACTOR FUEL ELEMENT. K. A. Keselring and A. U. Seybolt (to U. S. Atomic Energy Commission). U. S. Patent 2,863,814. Dec. 9, 1958.

A reactor fuel element of the capillary tube type is described. The element consists of a thin walled tube, sealed at both ends, and having an interior coating of a fissionable material, such as uranium enriched in U-235. The tube wall is gas tight and is constructed of titanium, zirconium, or molybdenum.

8424

NUCLEAR REACTOR. R. V. Moore, J. H. Bowen, and K. H. Dent (to U. S. Atomic Energy Commission). U. S. Patent 2,863,815. Dec. 9, 1958.

A heterogeneous, natural uranium fueled, solid moderated, gas cooled reactor is described, in which the fuel elements are in the form of elongated rods and are disposed within vertical coolant channels in the moderator symmetrically arranged as a regular lattice in groups. This reactor employs control rods which operate in vertical channels in the moderator so that each control rod is centered in one of the fuel element groups. The reactor is enclosed in a pressure vessel which is provided with access holes at the top to facilitate loading and unloading of the fuel elements, control rods and control rod driving devices.

8425

NEUTRONIC REACTOR FUEL ELEMENT. J. T. Stacy (to U. S. Atomic Energy Commission). U. S. Patent 2,863,816. Dec. 9, 1958.

A reactor fuel element having a core of molybdenum–uranium alloy jacketed in stainless steel is described. A barrier layer of tungsten, tantalum, molybdenum, columbium, or silver is interposed between the core and jacket to prevent formation of a low melting eutectic between uranium and the various alloy constituents of the stainless steel.

8426

REACTOR COOLANT TUBE SEAL. W. J. Morris (to U. S. Atomic Energy Commission). U. S. Patent 2,863,817. Dec. 9, 1958.

A pile-flattening control element and a fluid seal therefore to permit movement of the element into a liquid containing region of a neutronic reactor are described. The device consists of flattened, thin-walled aluminum tubing containing a uniform mixture of thermal neutron absorbing material, and a number of soft rubber closures for the process tubes, having slits capable of passing the flattened elements therethrough, but effectively sealing the process tubes against fluid leakage by compression of the rubber. The flattened tubing is sufficiently flexible to enable it to conform to the configuration of the annular spacing surrounding the fuel elements in the process tubes.

8427

JACKETED REACTOR FUEL ELEMENT. K. F. Smith and R. J. Van Thyne (to U. S. Atomic Energy Commission). U. S. Patent 2,863,818. Dec. 9, 1958.

A fuel element is described for fast reactors comprised of a core of uranium metal containing material and a jacket around the core, the jacket consisting of from 2.5 to 15 percent of titanium, from 1 to 5 percent of niobium, and from 80 to 96.5 percent of vanadium.

8428

PROCESS FOR DECONTAMINATING LIQUID FLUOROCARBONS OF OIL SUSPENDED THEREIN. H. Schneider and B. J. Massey (to U. S. Atomic Energy Commission). U. S. Patent 2,860,830. Dec. 9, 1958.

Decontamination of a bulk of liquid fluorocarbon contaminated with oil and water can be accomplished by passing the contaminated material through a bed of either silica gel, activated alumina or activated carbon to absorb the contaminants.

8429

SEPARATION OF PLUTONIUM FROM LANTHANUM BY CHELATION-EXTRACTION. R. A. James and S. G. Thompson (to U. S. Atomic Energy Commission). U. S. Patent 2,863,892. Dec. 9, 1958.

Plutonium can be separated from a mixture of plutonium and lanthanum in which the lanthanum to plutonium molal ratio is at least five by adding the ammonium salt of N-nitrosoarylhydroxylamine to an aqueous solution having a pH between about 3 and 0.2 and containing the plutonium in a valence state of at least +3, to form a plutonium chelate compound of N-nitrosoarylhydroxylamine. The plutonium chelate compound may be recovered from the solution by extracting with an immiscible organic solvent such as chloroform.

8430

SERVOMOTOR CONTROL SYSTEM. S. M. MacNeille (to U. S. Atomic Energy Commission). U. S. Patent 2,864,042. Dec. 9, 1958.

Control systems for automatic positioning of an electric motor operated vapor valve are described which is operable under the severe conditions existing in apparatus for electro-magnetically separating isotopes. In general, the system includes a rotor for turning the valve comprising two coils mounted mutually perpendicular to each other and also perpendicular to the magnetic field of the isotope separating apparatus. The coils are furnished with both a-c and d-c current by associate control circuitry and a position control is provided for varying the ratio of the a-c currents in the coils and at the same time, but in an inverse manner, the ratio between the d-c currents in the coils is varied. With the present system the magnitude of the motor

torque is constant for all valves of the rotor orientation angle.

8431

SEPARATION OF URANIUM, PLUTONIUM, AND FISSION PRODUCTS. R. Spence and M. W. Lister (to U. S. Atomic Energy Commission). U. S. Patent 2,864,664. Dec. 16, 1958.

Uranium and plutonium can be separated from neutron-irradiated uranium by a process consisting of dissolving the irradiated material in nitric acid, saturating the solution with a nitrate salt such as ammonium nitrate, rendering the solution substantially neutral with a base such as ammonia, adding a reducing agent such as hydroxylamine to change plutonium to the trivalent state, treating the solution with a substantially water immiscible organic solvent such as dibutoxy diethylether to selectively extract the uranium, making the residual aqueous solution acid with nitric acid, adding an oxidizing agent such as ammonium bromate to oxidize the plutonium to the hexavalent state, and selectively extracting the plutonium by means of an immiscible solvent, such as dibutoxy diethylether.

8432

REDUCTION OF PLUTONIUM TO Pu^{+3} BY SODIUM DITHIONITE IN POTASSIUM CARBONATE. D. R. Miller and H. R. Hoekstra (to U. S. Atomic Energy Commission). U. S. Patent 2,864,665. Dec. 16, 1958.

Plutonium values are reduced in an alkaline aqueous medium to the trivalent state by means of sodium dithionite. Plutonium values are also separated from normally associated contaminants by metathesizing a lanthanum fluoride carrier precipitate containing plutonium with a hydroxide solution, performing the metathesis in the presence of about 0.2 M sodium dithionite at a temperature of between 40 and 90°C.

8433

PRODUCTION OF URANIUM TETRACHLORIDE. V. P. Calkins (to U. S. Atomic Energy Commission). U. S. Patent 2,864,666. Dec. 16, 1958.

A process is described for the production of uranium tetrachloride by contacting uranium values such as uranium hexafluoride, uranium tetrafluoride, or uranium oxides with either aluminum chloride, boron chloride, or sodium aluminum chloride under substantially anhydrous conditions at such a temperature and pressure that the chlorides are maintained in the molten form and until the uranium values are completely converted to uranium tetrachloride.

8434

ANIONIC EXCHANGE PROCESS FOR THE RECOVERY OF URANIUM AND VANADIUM FROM CARBONATE SOLUTIONS. R. H. Bailes, D. A. Ellis, and R. S. Long (to U. S. Atomic Energy Commission). U. S. Patent 2,864,667. Dec. 16, 1958.

Uranium and vanadium can be economically purified and recovered from non-salt roast carbonate leach liquors by adsorption on a strongly basic anionic exchange resin and subsequent selective elution by one of three alternative methods. Method I comprises selectively eluting uranium from the resin with an ammonium sulfate solution followed by eluting vanadium from the resin with either 5 M NaCl, saturated $(NH_4)_2CO_3$, saturated $NaHCO_3$, 1 M NaOH, or saturated SO_2 solutions. Method II comprises selectively eluting vanadium from the resin with either concentrated NaCl or SO_2 solutions subsequent to pretreatment of the column with either SO_2 gas, 1 N HCl, or 0.1 N H_2SO_4 followed by eluting uranium from the resin with solutions containing 0.9 M NH_4Cl or NaCl and 0.1 HCl. Method III comprises flowing the carbonate leach solution through a first column of a strongly basic anionic exchange resin until vanadium breakthrough occurs, so that the effluent solution is enriched in uranium content and the vanadium is chiefly retained by the resin, absorbing the uranium from the enriched effluent solution on a second column of a strongly basic anionic exchange resin, pretreating the first column with either 0.1 N HCl, 0.1 H_2SO_4, CO_2 gas, or ammonium sulfate, selectively eluting the vanadium from the column with saturated SO_2 solution, pretreating the second column with either 0.1 N HCl or SO_2 gas, selectively eluting residual vanadium from the column with saturated SO_2 solution, and then eluting the uranium from the column with either 0.1 N HCl and 1 N NaCl or 0.1 N HCl and 1 N NH_4Cl.

8435

URANIUM EXTRACTION PROCESS. W. H. Baldwin and C. E. Higgins (to U. S. Atomic Energy Commission). U. S. Patent 2,864,668. Dec. 16, 1958.

A process is described for recovering uranium values from acidic aqueous solutions containing hexavalent uranium by contacting the solution with an organic solution comprised of a substantially water-immiscible organic diluent and an organic phosphate to extract the uranium values into the organic phase. Carbon tetrachloride and a petroleum hydrocarbon fraction, such as kerosene, are suitable diluents to be used in combination with organic phosphates such as dibutyl butylphosphonate, tributyl phosphine oxide, and tributyl phosphate.

8436

FORMING PROTECTIVE FILMS ON METAL. D. H. Gurinsky, O. F. Kammerer, J. Sadofsky, and J. R. Weeks (to U. S. Atomic Energy Commission). U. S. Patent 2,864,731. Dec. 16, 1958.

Methods are described of inhibiting the corrosion of ferrous metal by contact with heavy liquid metals such as bismuth and gallium at temperatures above 500°C generally by bringing nitrogen and either the metal zirconium, hafnium, or titanium into reactive contact with the ferrous metal to form a thin adherent layer of the nitride of the metal and thereafter maintaining a fractional percentage of the metal absorbed in the heavy liquid metal in contact with the ferrous metal container. The general purpose for using such high boiling liquid metals in ferrous containers would be as heat transfer agents in liquid-metal-fueled nuclear reactors.

8437

NUCLEAR REACTORS. E. Long and J. W. Ashley (to U. S. Atomic Energy Commission). U. S. Patent 2,864,759. Dec. 16, 1958.

A graphite moderator structure is described for a gas-cooled nuclear reactor having a vertical orientation wherein the structure is physically stable with regard to dimensional changes due to Wigner growth properties of the graphite, and leakage of coolant gas along spaces in the structure is reduced. The structure is comprised of stacks of uniform right prismatic graphite blocks positioned in layers extending in the direction of the lengths of the blocks, the adjacent end faces of the blocks being separated by pairs of tiles. The blocks and tiles have central bores which are in alignment when assembled and are provided with cooperating keys and keyways for physical stability.

8438

PROCESS FOR THE RECOVERY OF PLUTONIUM. H. A. Potratz (to U. S. Atomic Energy Commission). U. S. Patent 2,864,841. Dec. 16, 1958

A process for the separation of plutonium from uranium and other associated radioactive fission products is described consisting of contacting an acid solution containing plutonium in the tetravalent state and uranium in the hexavalent state with enough ammonium carbonate to form an alkaline solution, adding cupferron to selectively form plutonium cupferride, then recovering the plutonium cupferride by extraction with a water immiscible organic solvent such as chloroform.

8439

PUMPS FOR LIQUID CURRENT-CONDUCTING MATERIAL. D. A. Watt (to U. S. Atomic Energy Commission). U. S. Patent 2,865,291. Dec. 23, 1958.

An induction-type liquid conductor pump is described wherein the induced current flow is substantially transverse to the flow of the liquid in the duct, thus eliminating parallel current flow that tends to cause unwanted pressures resulting in turbulence, eddy-flow, heating losses, and reduced pumping efficiency. This improvement is achieved by offering the parallel current a path of lower impedance along the duct than that offered by the liquid so that the induced currents remaining in the liquid flow in a substantially transverse direction. Thick copper bars are brazed to the liquid duct parallel to the flow, and additional induced currents are created in the copper bars of appropriate magnitude to balance the ohmic drop in the current paths outside of the liquid metal.

8440

PROCESS OF PURIFYING URANIUM. G. T. Seaborg, E. F. Orlemann, and L. H. Jensen (to U. S. Atomic Energy Commission). U. S. Patent 2,865,703. Dec. 23, 1958.

A method of obtaining substantially pure uranium from a uranium composition contaminated with light element impurities such as sodium, magnesium, beryllium, and the like is described. An acidic aqueous solution containing tetravalent uranium is treated with a soluble molybdate to form insoluble uranous molybdate which is removed. This material after washing is dissolved in concentrated nitric acid to obtain a uranyl nitrate solution from which highly purified uranium is obtained by extraction with ether.

8441

METHOD OF SEPARATING URANIUM, PLUTONIUM AND FISSION PRODUCTS BY BROMINATION AND DISTILLATION. A. H. Jaffey and G. T. Seaborg (to U. S. Atomic Energy Commission). U. S. Patent 2,865,704. Dec. 23, 1958.

The method for separation of plutonium from uranium and radioactive fission products obtained by neutron irradiation of uranium consists of reacting the irradiated material with either bromine, hydrogen bromide, aluminum bromide, or sulfur and bromine at an elevated temperature to form the bromides of all the elements, then recovering substantially pure plutonium bromide by distillation in combination with selective condensation at prescribed temperature and pressure.

8442

IMPROVEMENT UPON THE CARRIER PRECIPITATION OF PLUTONIUM IONS FROM NITRIC ACID SOLUTIONS. R. A. James and S. G. Thompson (to U. S. Atomic Energy Commission). U. S. Patent 2,865,705. Dec. 23, 1958.

A process is reported for improving the removal of plutonium by carrier precipitation by the addition of nitrite ions to a nitric acid solution of neutron-irradiated uranium so as to destroy any hydrazine that may be present in the solution since the hydrazine tends to complex the tetravalent plutonium and prevents removal by the carrier precipitate, such as bismuth phosphate.

8443

METHOD OF PURIFYING URANIUM METAL. R. E. Blanco and B. H. Morrison (to U. S. Atomic Energy Commission). U. S. Patent 2,865,737. Dec. 23, 1958.

The removal of impurities from uranium metal can be done by a process consisting of contacting the metal with liquid mercury at 300°C, separating the impurity-containing slag formed, cooling the slag-free liquid substantially below the point at which uranium mercuride solids form, removing the mercury from the solids, and recovering metallic uranium by heating the solids.

8444

NEUTRONIC REACTOR. H. B. Stewart (to U. S. Atomic Energy Commission). U. S. Patent 2,865,826. Dec. 23, 1958.

A nuclear reactor of the type specifically designed for the irradiation of materials is discussed. In this design a central cylindrical core of moderating material is surrounded by an active portion comprised of an annular tank containing fissionable material immersed in a liquid moderator. The active portion is in turn surrounded by a reflector, and a well is provided in the center of the core to accommodate the materials to be irradiated. The over-all dimensions of the core in at least one plane are equal to or greater than twice the effective slowing down length and equal to or less than twice the effective diffusion length for neutrons in the core materials.

8445

POWER GENERATION FROM LIQUID METAL NUCLEAR FUEL. O. E. Dwyer (to U. S. Atomic Energy Commission). U. S. Patent 2,865,827. Dec. 23, 1958.

A nuclear reactor system is described wherein the reactor is the type using a liquid metal fuel, such as a dispersion of fissile material in bismuth. The reactor is designed in the form of a closed loop having a core section and heat exchanger sections. The liquid fuel is circulated through the loop undergoing fission in the core section to produce heat energy and transferring this heat energy to secondary fluids in the heat exchanger sections. The fission in the core may be produced by a separate neutron source or by a self-sustained chain reaction of the liquid fuel present in the core section. Additional auxiliary heat exchangers are used in the system to convert water into steam which drives a turbine.

8446

SLUG EJECTOR. H. W. Bellas and R. N. Lyon (to U. S. Atomic Energy Commission). U. S. Patent 2,865,829. Dec. 23, 1958.

An apparatus is presented for removing fuel elements from a reactor fuel tube that will reduce wear on the tube surfaces and will prevent the possibility of rupturing the fuel element protective jacket within the reactor during the refueling operation. An auxiliary

aluminum track comprising two ribbons or sheets in laminable relationship, the inner of which has spaced protuberances nesting within holes in the other, is inserted under the fuel element. When one sheet is moved relative to the other, the protuberances are pulled up and out of the holes and rest on the upper surface of the lower sheet. In this position the track supports the fuel element above the ribs of the tube. Since the track has a greater bearing surface than the ribs, the slugs may be pushed out of the reactor while resting on the track with much less friction than would be otherwise created.

8447

ELECTROLYTIC DISSOLUTION OF STAINLESS STEEL. E. C. Pitzer (to U. S. Atomic Energy Commission). U. S. Patent 2,865,832. Dec. 23, 1958.

A method is described for electrolytic dissolution of stainless steel in a nitric acid solution. The stainless steel object is kept in contact with either a tantalum, titanium, or zirconium anode in the electrolytic cell. Some constituents, including niobium, niobium carbide, and silicon, are not dissolved and must be removed from the anode surface by agitation in order to maintain a prescribed current.

8448

PERIODICALLY OPERATING THERMONUCLEAR D-D FUSION REACTION IN WHICH THE REACTION TEMPERATURE IS PRODUCED BY CONDENSER DISCHARGE. Albrecht Fischer. German Patent DAS 1022 711. Atompraxis 4, 476(1958). (In German)

8449

NEW METHOD FOR THERMAL BREEDING OF PLUTONIUM. Kurt Diebner. German Patent DAS 1028 249. Atompraxis 4, 477(1958). (In German)

8450

NEW FUEL ELEMENT IN WHICH THE DANGER OF AN ATOMIC EXPLOSION WOULD BE LESSENED. (to United Kingdom Atomic Energy Authority). German Patent DAS 1030 475. Atompraxis 4, 477(1958). (In German)

8451

IMPROVEMENT OF THE HEAT STABILITY OF IRRADIATED POLYETHYLENE BY A SYNTHETIC LACQUER COAT. (to General Electric Co., U.S.A.). German Patent DAS 1032 135. Atompraxis 4, 477 (1958). (In German)

8452

GASEOUS COOLANT FOR NUCLEAR REACTORS BASED ON THE INCREASED HEAT CAPACITY OF DISSOCIATED GASES. (to Siemens-Schuckertwerke AG., Germany). German Patent DAS 1033 344. Atompraxis 4, 477(1958). (In German)

8453

NEW METHOD FOR THE PRODUCTION OF URANIUM TETRAFLUORIDE. (to United Kingdom Atomic Energy Authority). German Patent DAS 1033 647. Atompraxis 4, 477(1958). (In German)

8454

FUEL ELEMENTS OF URANIUM GLASS FOR NUCLEAR REACTORS. (to Siemens-Schuckertwerke AG., Germany). German Patent DAS 1033 807. Atompraxis 4, 477(1958). (In German)

8455

MEASUREMENT OF THE RADIOACTIVITY OF LIQUIDS BY EVAPORATION OF THE LIQUIDS AND INVESTIGATIONS OF THE DRY RESIDUES. (to Frieseke & Hoepfner GmbH., Germany). German Patent DAS 1028 248. Atompraxis 4, 478(1958). (In German)

8456

SPONGE-LIKE CERAMIC FUEL ELEMENT MATERIAL OF POSSIBLY BETTER HEAT EMISSION IN NUCLEAR REACTORS. (to Stichting Reactor Centrum Nederland, Netherlands). German Patent DAS 1033 810. Atompraxis 4, 478(1958). (In German)

8457

DEVICE FOR SAMPLING GASES. (To Atomic Energy of Canada Ltd. (U.S.A.).) British Patent 791,845. Nuclear Eng. 4, 48(1959) Jan.

An aerosol sampling device based on the impaction principle is described. The detection of alpha-emitting materials in the form of aerosols is difficult, because the activities to be measured are very low, and natural radon decay products may completely mask that due to concentrations of more toxic contaminants. It has been noted that radon decay products are preferentially associated with smaller dust particles; 90% of radon decay produces activity on particles of less than 0.035 microns diam. On the other hand, if material is rendered airborne by mechanical disruption, the bulk of the material is in the larger particle sizes, with only a very small fraction of the mass in sizes of less than 1 micron diam. By separating airborne particles into two groups, greater and less than 1 micron diam., samples of active dust from escapes or spills in industrial and laboratory processes can be obtained free from radon decay products. Available devices effecting separation of this kind have a sampling rate of about 20 l/min. Rapid detection, however, e.g., of airborne plutonium or other alpha- and beta-gamma-active materials require a rate of 400 to 1,000 liters per minute. The device achieves this result by lightly drawing air (by a conventional vacuum cleaner blower) through a jet arrangement against a greased tray at the end of the suction tube, where the very fine particles collect on the tray, and can be examined after a few minutes with an alpha-sensitive scintillation counter.

8458

NUCLEAR REACTIONS. T. Volochine. British Patent 795,596. Nuclear Eng. 4, 48(1959) Jan.

A fusion-type reaction with a substantial release of power is reported. The probability figures for effective encounters and fusion reactions between nucleons and between nucleons and atomic nuclei can be increased by so arranging matters that the reagent particles are all presented to the reaction area under such conditions that their magnetic moments are so related as to contribute to bringing the particles towards one another. These conditions can be brought about by subjecting both reagent parts to a polarizing magnetic field, so directed in each case that it aids the encounter fusion of the individual particles. The precise field and the optimum paths are to be predetermined in accordance with the nature and characteristics of the particular nucleus to be produced, specifically with the values of the magnetic moment and spin thereof. Certain stability conditions have also to be taken into account and the internal structure of the reagent. Any means may be used to create the desired polarizing field such as solenoids, magnetic fields, etc.

8459

ION SOURCES. M. von Ardenne. British Patent 795,766. Nuclear Eng. 4, 48(1959) Jan.

In mass spectrographs and magnetic isotope separators certain properties are desirable such as high emission density in the ion emission aperture, high plasma stability, high commercial efficiency (over 10%), uniform emission characteristics and small dispersion of the initial velocity of the ions, for magnetic isotope separators a large emitting area, small beam aperture in the plane at right angles to the direction of the separating magnetic field, and a very small beam aperture in the plane parallel to this direction. A convergence should be given to the ion beam in the plane parallel to the direction of the magnetic field with a beam crossover in its central zone. No auxiliary magnetic field should be required. This is achieved by the arrangement of an intermediate electrode disposed between anode and cathode of an ion source in which a low-pressure gas discharge is effected which is constricted by an aperture in the intermediate electrode. The anode region of the plasma produced by the discharge is to be situated directly in front of an ion emission aperture of the anode. The (externally situated) ion source is combined with a magnetic isotope separator with a magnetic field extending over a sector of 90 to 60 deg.

8460

NUCLEAR REACTORS. H. Chilton (to C. A. Parsons and Co., Ltd.). British Patent 796,966. Nuclear Eng. 4, 48(1959) Jan.

In boiling water reactors, circulation of the water requires large pumps and large ducts passing through the walls of the reactor vessel. To avoid this, use can be made of natural circulation, induced by the difference in density between the water in the space between the fuel duct and the vessel walls and the water-steam mixture in the fuel ducts. The rate of circulation is limited by the available head but can be assisted by making use of an injector effect. Nozzles are arranged at the inlets of the fuel ducts and water withdrawn from the vessel and pumped through these nozzles at high velocity produces this effect and assists the natural circulation. Feedwater can be used, instead of withdrawing water from the vessel, for supplying the nozzles.

8461

MOISTURE PROOFING OF LUMINESCENT THALLIUM-ACTIVATED SODIUM IODIDE. M. J. Toogood (to E. K. Cole, Ltd.). British Patent 796,187. Nuclear Eng. 4, 48(1959) Jan.

Any superficial moisture is removed, and a coating of an epoxy resin is applied which is then cured. The product may be used without a metal container.

8462

DOSIMETER FOR EVALUATING THE DOSAGE OF PENETRATING RADIATION. (To General Aniline and Film Corp. (U.S.A.).) British Patent 796,239. Nuclear Eng. 4, 48(1959) Jan.

A casing opaque to actinic light (aluminum or polymethyl-methacrylate or polystyrene) has a gamma-ray intensifier screen in an opening and a modulating wedge with steps of increasing densities in contact with it adjacent to a light sensitive element with a high-speed print-out emulsion. The casing can be closed and the emulsion side of the photographic element raised (rotated) and viewed through a window with filter. The wedge bears characters which become visible as white dots the number of which corresponds to the intensity of the radiation. Post-exposure may be effected.

8463

PROCESS FOR PRODUCTION OF URANIUM. (To U. K. Atomic Energy Authority (U.S.A.).) British Patent 796,589. Nuclear Eng. 4, 48(1959) Jan.

It has been found that close control of the particle size of the uranium tetrafluoride is important in obtaining massive uranium in relatively high yields. The particle size should preferably be such that 90% passes a 60 mesh sieve, 85% an 80 mesh, 75% a 100 mesh, and 50% a 200 mesh sieve. The excess granular calcium used for the reduction at elevated temperature has a particle size not greater than 7 mesh. Very fine calcium should be present for initiating the reaction. The calcium tends to vaporize and intimately mix with the uranium tetrafluoride. Yields range from 80% to 95% of the theoretical yield.

8464

GAS LUBRICATED BEARINGS. A. G. Montgomery and F. Sterry (to U. K. Atomic Energy Authority). British Patent 796,926. Nuclear Eng. 4, 48(1959) Jan.

When using gas lubricated bearings, instability of the rotor occurs under certain conditions, and may develop into violent back and forth movements of the rotor across a diameter of the bearing (as an oscillating piston in a double-ended cylinder). An incipient oscillation is also present determined by the mass of the rotor and the load/displacement characteristic of the bearing. The clearance between rotor and bearing shell is of importance for this oscillation and, therefore, has to be kept extremely small (0.0005 in.) and only very small tolerances are thus permissible. This clearance, however, can be raised to the order of 0.003 in. for an 0.75 in. rotor diameter by arranging the bearing sleeve in a resilient mounting, preferably as a porous metal sleeve surrounded by two rubber rings at each end which also act as gas seals in an annular chamber under gas pressure around the sleeve.

8465

NEUTRONIC REACTOR FUELS. (To General Electric Co. (U.S.A.).) British Patent 796,989. Nuclear Eng. 4, 92(1959) Feb.

Fuel elements constructed from alloys of uranium-235 and a metal, such as aluminum or zirconium, containing a fine, even dispersion of boron-10 are reported. As these fuel elements are consumed, the boron-10 particles which have a very high neutron capture cross section are gradually transmuted to lithium which has a much lower neutron capture cross section. The alloying metal acts as a relatively inert diluent for the uranium and also reduces the rate of corrosion of the uranium at elevated temperatures. With such fuel elements the amount of external control to regulate the rate of reaction is reduced as the ratio of the number of neutrons produced to the original number of neutrons initiating the fissions remains virtually constant over a long period.

8466

NUCLEAR REACTORS. J. Diamond and J. Smith (to U. K. Atomic Energy Authority). British Patent 796,991. Nuclear Eng. 4, 92(1959) Feb.

Certain advantages of natural water moderated reactors are counteracted by the disadvantages of low critical temperature coupled with high critical pressure, which have also to be considered when using heavy water or liquid hydrocarbons as moderators. Such disadvantages can be overcome by heat insulation

between channels carrying the reactor coolant and the moderator, by a gas space, with or without a solid insulator. The arrangement is particularly useful in sodium cooled water moderated reactors. An insulating space also acts as a barrier and, in case of leaks, an inert scavenging gas circulated through the insulating channels can be used to detect such leakage.

8467

LOW TEMPERATURE NUCLEAR REACTORS. (To Allmänna Svenska Elektriska AB. (Sweden).) British Patent 797,485. Nuclear Eng. 4, 92(1959) Feb.

In reactors adapted for heating purposes the desired temperature of the cooling medium leaving the reactor is about 130°C. at which a pressure of 7 atm. is sufficient to prevent boiling. Instead of having the cooling system only under pressure, a common moderator and cooling system is provided under the same pressure, the heavy water first flowing through the moderator vessel and then serving as cooling medium flowing through tubes around the fuel rods. The pressure vessel surrounding the reactor vessel is filled with neutron reflecting material (graphite). The cover for the reactor vessel is built as a collecting vessel into which run the tubes containing the fuel rods. The reactor vessel then may be made thin to reduce neutron absorption.

8468

APPARATUS FOR GENERATING ELECTRICITY BY THERMIONIC EMISSION. H. Hurst. British Patent 797,872. Nuclear Eng. 4, 92(1959) Feb.

A thermionic cell with two or more electrodes in a heat-resisting envelope which may be evacuated or contain gas or vapor is heated externally to cause a flow of electrons from an emissive electrode to a collector electrode such that, when these electrodes are connected through an external load circuit, a net current flows through the system. Pellets of radioactive material may be embedded in the emissive material or external irradiation may be carried out by exposure to a radiation source and may be made selective by shielding. Cells may be connected to systems either in series or parallel to increase voltage or current.

8469

MANIPULATING DEVICES. J. Britt (to Rolls-Royce, Ltd.). British Patent 797,882. Nuclear Eng. 4, 92(1959) Feb.

The device is intended for handling articles by remote control, e.g., in a space containing liquid sodium at high temperature from which the mechanism must be protected, and which itself must not be contaminated by any lubricant or coolant. A rigid tubular casing with straight portions connected by a curved portion is provided with internal guide faces for a girder structure of a pair of flexible strips and interconnecting links. The strips are in sliding contact with the guide faces and by interlocking of the links and strips in one straight portion, a rigid structure is formed capable of supporting bending loads in the center-plane of the curved section of the casing. The interlocking and unlocking is effected by projecting the girder member more or less from the end of one straight portion. Suitable gripping means is carried at the operative end of the girder. The casing is made rotatable about an axis through one of its straight parts so as to be movable over a large area.

8470

PROCESS FOR THE PREPARATION OF CARBONACEOUS MATERIAL SUITABLE FOR USE IN A NUCLEAR REACTOR EITHER AS MODERATING MATERIAL OR IN THE CONSTRUCTION OF A REFLECTOR. (To N. V. De Bataafsche Petroleum Maatschappij (Netherlands)). British Patent 798,029. Nuclear Eng. 4, 92(1959) Feb.

Deuterated heavy aromatic hydrocarbon material is submitted to carbonization. The term "heavy aromatic hydrocarbon material" means material consisting wholly or mainly of one or more polycyclic compounds. The moderating effect of the material obtained by this process is considerably higher than that of graphite, for example.

8471

FUEL ELEMENTS FOR NUCLEAR REACTORS. G. D. Bell (to Atomic Energy Authority). British Patent 798,282. Nuclear Eng. 4, 92(1959) Feb.

The element consists of a hollow uranium cylinder with an inner zirconium sheath pressurized tight onto the uranium, and an outer zirconium sheath spaced from the uranium cylinder by a uniform 0.1 inch gap so as to have poor heat transfer. The outer sheath is contacted by inflowing coolant, the inner sheath by outflowing coolant. The outer sheath serves for carrying the fuel element in a zirconium lined channel of a graphite moderator structure and sustains all the stresses due to the weight of the fuel element while the inner sheath remains relatively unstressed.

8472

FUEL ELEMENTS FOR NUCLEAR REACTORS. A. Blainey and H. Lloyd (to U. K. Atomic Energy Authority). British Patent 798,434. Nuclear Eng. 4, 92(1959) Feb.

A tubular fuel element (enriched uranium) is provided with a sheath of a protective substance (beryllium) by compacting layers of the substance over and around the fuel tube. A removable core of lead, tin, bismuth or other low melting point metal to deform under compaction and transmit isotropic pressure is used to define the interior diameter of the element during compacting and subsequent sintering of the powdered sheath in a demountable die of "Nimonic" nickel–chromium alloy, or nickel titanium carbide.

8473

HEAT TRANSFER SYSTEMS. J. B. Morris (to U. K. Atomic Energy Authority). British Patent 798,441. Nuclear Eng. 4, 92(1959) Feb.

Into a bed of heat-generating particulate material is injected a liquid which, at a given bed temperature, flash-evaporates. The bed may be constituted by a powder of fissile and moderating material (i.e. a nuclear reactor core) into which water is injected and from which the flash is fed directly to a steam turbine system.

8474

NUCLEAR REACTORS. W. Macrae and A. L. Howie (to C. A. Parsons and Co., Ltd.). British Patent 798,466. Nuclear Eng. 4, 92(1959) Feb.

A control rod in articulated or link form is described. The links may have varying degrees of neutron-absorbing capacity and may be made of tubes filled with material producing fissile material under irradiation (e.g., thorium). The uppermost link rests with radial arms on the reactor core.

8475

IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. H. C. Knight and H. Morris (to United Kingdom Atomic Energy Authority). Nov. 12, 1958. British Patent 804,395. Nuclear Power 4, 108(1959) Feb.

In order to charge and discharge a fuel element with its thermocouple attached, the use of a load-bearing, flexible sheath, formed by a stainless steel wire helix, is proposed by the UKAEA (this could be Calder Hall). The thermocouple cable passed through the sheath which is attached, via screwed tapered pins and clamping nuts, at one end to a lifting block and at the other to a coupling boss. The lifting block screws into a section carrying the fuel element itself. The free end of the cable is attached to a terminal block. The boss connects with another coupling in which is clamped another length of hollow, flexible cable sheathed in stainless steel braiding. Into the other end of the cable fits a spigot connecting via a plug and a coupling flange to a stainless steel lifting wire. For charge/discharge operations, the cable is detached from its terminal block, the assembly of the lifting wire to the cable made, and the free end of the cable fed through. The union nut is then tightened to take the weight of the element.

8476

IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. P. P. Guneratne, M. Young, and G. H. French (to United Kingdom Atomic Energy Authority). Dec. 23, 1958. British Patent 806,490. Nuclear Power 4, 108 (1959) Feb.

Welding or brazing cannot be used for fixing a thermocouple pair to a fuel can because it involves association of at least three differing materials plus fluxes. In this alternative method, the can has one eccentric fin root near the base through which a hole, 0.0635 in. diam., is drilled, so that the minimum thickness between the hole and the sheath proper is the same as the normal fin thickness. The thermocouple cable, nominal diam. 0.0625 in., containing the hot junction is pushed through the hole clear of the fins, flattened to 0.070 in. over a length of 0.1 in., and then pulled back under load just inside the hole. The cable is led along the fuel element in slots cut in the fins.

8477

FUEL ELEMENT FOR NUCLEAR FISSION REACTORS. (To Deutsche Gold-und Silber-Scheideanstalt Vormals Roessler.) Dec. 23, 1958. British Patent 806,430. Nuclear Power 4, 108(1959) Feb.

The problem of xenon poisoning is the target in this invention by Degussa in which the fuel elements are porous and uncompacted with at least 5% pore volume and exposed directly to the coolant. The elements may take several forms, all of large surface/volume ratio. Particularly recommended is a compound form made up of rods, disks or tubes, but any small shape giving a uniform and reproducible packing density is possible. Thus a graphite, beryllium, or zirconium container, which can fill the whole reactor chamber, is filled with either rods or such shapes as balls, Raschig rings, saddles, etc. In an alternative arrangement the container can be in the form of vertical tubes, filled with spherical fuel which can be continually charged and discharged. Suitable compounds for the fuel are oxides, carbides, silicides, or fluorides of uranium and plutonium.

8478

IMPROVEMENTS IN OR RELATING TO CONTROL SYSTEMS FOR NUCLEAR REACTORS. (To Reyrolle & Co., Ltd.) Dec. 23, 1958. British Patent 806,409. Nuclear Power 4, 108(1959) Feb.

Combined control and shut-off rod by Reyrolle, a member of the Nuclear Power Plant Company, is suspended by a flexible chain or cable from a windlass drum, mounted on the horizontal spindle of a reduction gearbox which is driven by a variable speed electric motor with no clutch between the rod and the motor. A second gearbox connects the other end of the motor shaft to an electromagnetic induction brake. For emergency shut-down, the motor is de-energized and the rod allowed to fall, under gravity but controlled by the brake. The inertia of the driving train constituted by the motor, gearing and moving parts is sufficiently low for it to fall rapidly enough while remaining coupled to the motor, driving the de-energized motor in reverse through the gearing. Final deceleration is produced by the brake whose torque is automatically raised with the rod's position by means of the variable-ratio gearbox. Absence of clutch is claimed to lead to great reliability.